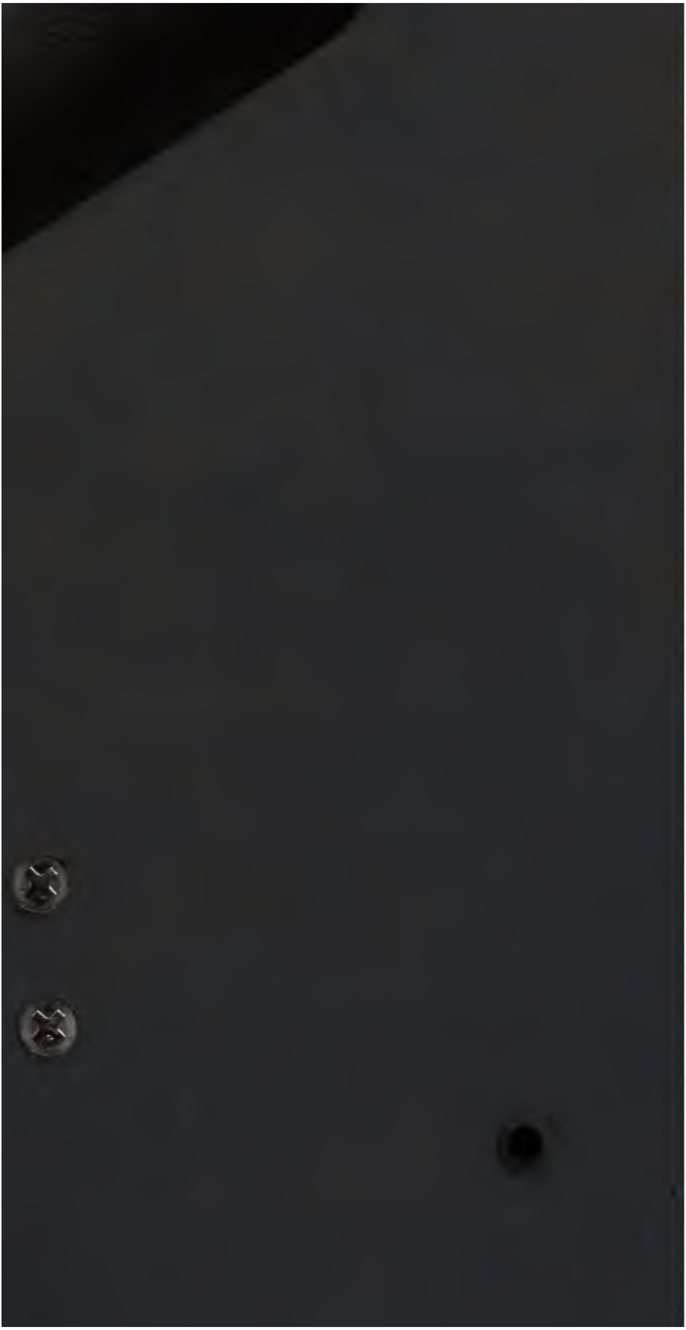

Geo

WILLIAM. SMITH

LITCHFIELD

MAINE

IMPROVED EDITION WITH QUESTIONS.

A

SHORT SYSTEM OF

PRACTICAL ARITHMETIC,

COMPILED

FROM THE BEST AUTHORITIES;

TO WHICH IS ANNEXED

A SHORT PLAN OF BOOK-KEEPING.

THE WHOLE DESIGNED

FOR THE USE OF SCHOOLS.

By WILLIAM KINNE, A. M.

Ninth Edition,

WITH QUESTIONS

ON EVERY PART OF ARITHMETIC, AND A COMPENDIOUS SYSTEM OF TAX MAKING.

REVISED, CORRECTED, AND GREATLY ENLARGED,

By DANIEL ROBINSON.

HALLOWELL:
GLAZIER, MASTERS & Co.
1833.

ADVERTISEMENT TO THE SEVENTH EDITION.

IT has been the primary purpose, in each improved Edition of this Work, to render it more and more plain and practical, while it should embrace every useful rule and question which might occur in the ordinary business transactions of life. To effect this object, neither time nor thought has been, in any wise, niggardly expended. Whatever was judged to be wanted, to characterize it as a plain, practical, and useful system, has been amply, though gradually, supplied. In the edition now presented to the public, part of the questions in which avoirdupois weight is concerned, has been written anew, or so altered as to allow 25 pounds only to the quarter of a hundred weight; because this practice now generally obtains in business, among merchants and traders in the United-States, and has moreover been established in Maine by legislative enactment. Considerable new matter also has been crowded into the volume, and a small portion of the old withdrawn. Errour has been diligently sought for and corrected; and, it is confidently believed, is now nowhere to be found on its pages. Considered as an Epitome, whether it be susceptible of any farther degree of improvement, may be reasonably questioned. The hope is, therefore, indulged, that, though the tongue of the captious caviller should blazon defects for which others might search in vain; yet the eye of the candid critic will see nothing in this compendium which reason and truth would long hesitate to approve. D. R.

Gardiner, August 1, 1828.

PREFACE.

To adapt this work to the easy use of Instructers, I have endeavoured to simplify the definitions and rules, so as to render them as familiar and concise as the nature of the subject admits. At the same time, I have very considerably enlarged the *Original System*, by the insertion of a far greater number of practical examples, especially in the ground-rules, and by the introduction of many new rules, in order to furnish our schools with a methodical and *comprehensive* Treatise of Practical Arithmetic.

Works of this kind have too often abounded with abstruse and intricate questions, more puzzling than beneficial to the learner.—And some authors have dwelt too much on those of a trifling nature, which, when understood, afford no useful knowledge. To avoid these extremes, to feed and invigorate the mind, and thus form our *youth* for entering, with fair promise, on the pursuits of active life, have been my principal aims, in preparing this edition for the press. Most of the former demonstrations have been omitted, as being little suited to enlighten the *pupil*, and as excluding, in such *compends*, matter much more conducive to the purpose of his instruction. The book-keeping, also, has been somewhat abridged, for the admission of other matter: yet enough, it is conceived, has been retained to give the student no very imperfect idea of this branch of learning. Besides what has been substituted in place of this excluded matter, no fewer than 51 pages have been added to the last edition. To the whole have been prefixed brief questions on all the most important parts of Arithmetic. But, instead of entering into a detail of these enlargements, I beg leave to refer the reader to the table of contents, or to the pages of the work itself.

During the many years that I have devoted to the instruction of youth in Arithmetic, I have used various systems, all of which have just claims to scientific merit. The authors, however, have, generally, appeared to be deficient in an important point—the practical teacher's experience. They have been much too sparing of *examples*, more especially in the *first* rules. The consequence is, that the scholar is hurried through these fundamental rules faster than his comprehension and proficiency would justify. To obviate this objection, has been another design in the present undertaking.

Considering that, to attain a thorough knowledge of *vulgar* fractions, is usually too difficult a task for young students, whose progress in Arithmetic has extended only to compound division, and that the difficulty frequently results in their utter discouragement; I have, therefore, deemed it most advisable and advantageous to transfer these fractions (except two or three problems introductory to decimals) beyond equation of payments. But as *decimal* fractions may be more easily acquired, are more simple, useful, and necessary, and are sooner wanted in the practical branches of numbers, I have thought it expedient to let them occupy that part of the work which they did in former editions. The other rules I have likewise aimed so to arrange, as to give precedence to those which are most simple and necessary, introducing the more abstruse and difficult parts last. The teacher, however, will not consider himself as being obliged to adhere strictly to this arrangement. He can, notwithstanding, take the rules in such order as *he* may conceive to be the most proper.

DANIEL ROBINSON.

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Topics for Examination in the Arithmetic.

What is *Arithmetic?* What are the four fundamental *Rules* for its operation? To understand these, what is *previously* necessary? What does *Notation* teach? How many characters or *figures* are employed in it? By what *common* term are the first *nine* called? How named? What does the *tenth* figure denote? Have not these digits a *local*, as well as a *simple* value? On what *principle* does their *local* value depend? Denominate the names of the *places*, according to their *order*. How is the *cipher* used, in *connexion* with the *significant* figures? In what manner are *large* numbers *divided?* Name the *places*, and read each line of *numbers*, in the *Numeration* Table. What is the *Rule* for expressing *numbers* in *figures* when above *nine?* Give the *Rule* to *read* numbers. What is *Addition? Simple?* Let me examine you in the Table. Recite the *Rule* and modes of *Proof*. What is *Subtraction?* When *Simple?* Name its *numbers*. Let me examine you in the Table. Give the *Rule* and way of *Proof*. What is *Multiplication?* Name its *numbers*. What *common* term is applied to the *first* two of them? When is it *Simple?* How is the *Table* used? Let me *examine* you in it. When is it Case *first?* Repeat the *Rule*. When Case *second?* Give the *Rule*, and modes of *Proof*. When does the *first* Case of *Contractions* apply? Give the *Rule*. When the *second* Case? Tell the *Rule*. What is shown by *Division?* Name its *numbers*. When is it *Simple?* Let me examine you in the Table. Repeat the *Rule*, *Notes*, and modes of *Proof*. Repeat the *directions* in Case *first* of *Contractions*. What Case *second* and *Rule?* What says Case *third?* What its *Note* and *Rule?* Repeat the *Money* Table. That of *Troy Weight*. *Apothecaries'* Weight. *Avoirdupois* Weight. *Cloth Measure*. *Long* Measure. *Square* Measure. *Cubic* Measure. *Dry* Measure. *Wine* Measure. *Ale* Measure. *Time*. *Planetary Motion*. What is taught by *Reduction?* Repeat the *Rules* and *Proof*. Tell me the mode of *formation*, and *Table* of *Federal Money*. Give the *Rule* for its *Addition*. For its *Subtraction*. For its *Multiplication*. Recite the *Note*, and *A Short Rule*. Give the *Rule* for its *Division*. Tell the *Short Rule*. Give the *Rules* for the *Reduction* of Federal Money. What is the *Direction* in Case *first* for changing New-England currency to Federal Money? In Case *second?* In Case *third?* What is the *Rule* in Case *first* for changing Federal Money to New-England currency? In Case *second?* What is taught by *Compound Addition?* Give the *Rule*. What is Compound *Subtraction?* Tell the *Rule*. What does Compound *Multiplication* teach? Give the *Rule*. What is the *direction* in Case *second?* What in Case *third?* What does Compound *Division* teach? Rehearse the *Rule*. What does Case *second* direct? What Case *third?* Tell the *Note* before examples in *Average Judgment*. What is observed of *Duodecimals?* Give the *Rule* for multiplying them. What are *Fractions?* How is a *Vulgar* Fraction *represented?* Name its *parts*. What is shown by the *Denominator?* What by the *Numerator?* When is a fraction in its *lowest terms?* Give the *rule* for Problem *first*. What is the *intent* of Problem *second?* Tell its *rule*. What of Problem

A 2

third? What its *rule?* What is a *Decimal* Fraction? How *expressed?* What *determines* its relative *value?* How are *such* fractions affected by *ciphers?* Let me hear the *Table.* What is the *rule* for their *Addition?* What for their *Subtraction?* For their *Multiplication?* Give the *Note.* What for their *Division?* Give the *Note.* What is the *rule* in the *first* Case for their *Reduction?* In *second* Case? In *third?* In *fourth?* In *fifth?* What are the *rules* in Case *first* of Reduction of *Currencies?* In case *second? third? fourth? fifth?* What are the *rules* for changing *Federal* Money into the *Currencies* of the several States? What for changing it to *Canada* and *Nova Scotia* money? What to that of *Great Britain?* What does the *rule of Three* teach? Why so *named?* Why called *Golden Rule?* Give the *rules,* and *notes* for its operation. What is *Practice?* What the *rule* in case *first?* What says Case *second,* and what its *rule?* What are *Tare* and *Tret?* Define all its *terms.* When is Case *first* used, and what its *rule?* When Case *second,* and what the *rule?* Case *third,* and what the *rule? Fourth,* and what the *rule?* What does the *Double Rule of Three* teach? How many *terms* in its questions? How *distinguished?* Give the *rule* and *notes.* What is Conjoined *Proportion?* When is Case *first* used, and what its *rules?* When Case *second,* and what its *rule?* What is *Barter?* Its *rule?* What *Loss and Gain?* In what instruct *Merchants* and *traders?* How its *questions* solved? What its general *law?* What is *Fellowship?* Its *use?* What *Single* Fellowship? Its *Rule?* How *proved?* What *Double* Fellowship? Its *Rule?* What is *Interest?* What the *legal* interest? Define its *terms.* How many *kinds?* What *Simple?* Its *Rule* and *Note?* Tell the *Table* of Aliquot Parts? What the *Rule* for *Months,* at 6 per cent.? For *days* at ditto? What the *Short Practical Rule* for *pounds,* &c. at ditto? How serve at 5 or 7 per cent.? What the *Short Rule* for *Federal Money,* at 6 per cent.? How proceed at 5 or 7 per cent.? What the *first* Rule to compute Interest on *Notes, &c.* having *Endorsements?* How the Rule *contracted?* What the *Rule* in *Massachusetts?* What *Compound* Interest? What the *Rule?* What *Commission* and *Brokerage?* What *Insurance?* What *Discount?* What *Present Worth?* What the *Rules?* What the *Rule* when there are *several* sums to be paid, &c.? What an *Annuity?* How in *Arrears?* What meant by *Amount?* What by *Present worth?* How is the *Amount* found at Simple Interest? How the *Present worth?* What *Equation of Payments?* What the *Rule?* What known by *Exchange?* Tell the *Table.* What the *Rules?* How many *kinds* of Vulgar *Fractions?* What a *Proper* one? *Improper? Single? Compound? Mixed?* How turn a *whole* number to a *Fraction?* What a *Complex* one? What does a fraction *denote?* What its value *equal* to? What meant by *Common Measure?* What by *Common Multiple?* Give the *Rules* of Problem *first.* Of Problem *second.* What is *Reduction* of Vulgar Fractions? Repeat the *last part* of the Rule in Case *first.* What the *Rule* in Case *second?* What in Case *third?* In Case *fourth?* Those in Case *fifth?* Tell the *Rule* in Case *sixth.* What the *Rule* in Case *eighth?* What are the *Rule* and *Notes* in *Addition* of Vulgar Fractions? What in *Subtraction?* What in *Multiplication?* What in *Division?* How do you proceed in the *Rule of Three* in Vulgar Fractions? How in the Rule of Three in *Decimals?* How in the *Double Rule of Three* in Vulgar Fractions? Tell the *Table of Ratios*

in Simple Interest by *Decimals*. What is *Ratio*? How do you find the *Interest*? What the Rule in Case *second*? In Case *third*? Case *fourth*? How find Interest for *Days*? How calculated on *Cash Accounts* where partial *payments* are made? How find *Compound Interest* by *Decimals*? How find *Amount* of an *Annuity* at *Compound Interest*? How its *Present Worth* at ditto? What is *Involution*? What the *first* Power? What the *second*? The *third*? The *fourth*? What *Evolution* or Extraction of *Roots*? What the *Root*? Can the Root of *any* number be found? How *approximate* towards it? What are Roots *called*? What is a *Square*? What Extracting the *Square* Root? What the *Rules*? What when a *Vulgar Fraction*? What the Rules in its *Application* and *Use*? What a *Cube*? What is, to Extract the *Cube* Root? What the *Rule*? What the *note*, *proposition*, and *rule* in its Application and Use? What the *Rules* to Extract Roots *generally*? What the *Note*? When are *Numbers* in Arithmetical *Progression*? What form *increasing*? What *decreasing*? How *named*? What TERMS given? What *found*? What the whole number *called*? What Problem *first* and *rule*? *Second* and *rule*? *Third* and *rule*? When are numbers in *Geometrical* Progression? What called *ratio*? What Problem *first* and *rule*? What Problem *second*, Case *first* and *rules*? What Case *second*, *rules* and *note*? What does *Alligation* teach? How *distinguished*? What Alligation *Medial*? What the *rule*? What *Alternate*? What the *rules*? What *Position*? How many *kinds*? What taught by *Single* Position? What the *rule*? What by *Double* Position? What the *rules* and *note*? What *Permutation*? What *Combination*? What Problem *first* and *rule*? What Problem *second* and *rule*? What Problem *third* and *rule*? How are *Grindstones* sold? How are their Contents *found*? What is *Superficial Measure*? How *made up*? What is *measured* by it? What Case *first* and *rule*? Case *second* and *rule*? What the *Note*? What a *Triangle*? How its *Surface* measured? How the *Superficies* of *Joists* and *Planks* found? How measure *irregular* Surfaces? What a *Circle*? How find *circumference* if *diameter* be given? How *diameter* if *circumference* be given? How find *Area*? How, if circumference *alone* be given? How find *diameter* by the *area*? How *circumference* by the *area*? What is a *Sector*? How *measured*? By Rule *second*? What a *Segment* of a Circle? How find its *area*? How measure a regular *Polygon*? How describe an *ellipse* or *oval*? How find its *area*? What is a *Sphere* or *Globe*? How find its *area*? How are *Solids* measured? What is a *Cube*? How *measured*? What Case *second* and *rule*? What *noted*? What Case *third* and *rule*? What a *Cylinder*? How *measured*? What Case *fifth* and *rule*? Case *sixth* and *rule*? Case *seventh* and *rule*? What is a *Cone* or *Pyramid*? How its *solidity found*? What the *Note*? What a *Frustum* of a Cone? How find its *solidity*, if a *square* pyramid? How, if a *triangular* pyramid? How, if a *circular* pyramid, or cone? What is a *Globe*? How find its solid *content*? What a *Frustum* of a sphere? How find its solid *content*? What is *Gauging*? What its *rule* and *notes*? How use the *Sliding rule*? How gauge *round tubs*? How a *square* vessel? What the *Note*? How find a ship's *Tonnage*? What the *Note*? What Section *fifth* and *rule*? Section *sixth* and *rule*? How find the *solidity* of *Wood* and *Bark*? How find the *Cords* in a pile of either? What the *principal rules* in *Assessing Taxes*? What the *general* Rules in common *Book-keeping*?

ARITHMETICAL MARKS AND SIGNS.

$=$The sign of equality, and is pronounced, *equal to;*
$+$The sign of Addition, and is pronounced, *added to;*
$-$The sign of Subtraction, and is pronounced, *subtracted by.*

EXAMPLES.

$12+7=19$, twelve added to seven will be equal to nineteen.

$23-8=15$, twenty-three substracted by eight, equal fifteen.

$\times$ The sign of multiplication, and is pronounced, *Multiplied into;*
$\div$The sign of Division, and is pronounced, *divided by.*

EXAMPLES.

$8\times7=56$, eight multiplied into seven equal fifty-six.
$36\div4=9$, thirty-six divided by four, equal nine.
Division is also implied by the signs 3)6(2 and $\frac{6}{3}=2$, six divided by three, equal two.

: : : : The sign of proportion, and is pronounced, *is to, so is, to.*

EXAMPLE.

$6:9::8:12$, as 6 is to 9 so is 8 to 12.

$\sqrt{}$or $^{\frac{1}{2}}$ signifies the Square Root: thus $\sqrt{81}$ is read, the square root of 81; or $81^{\frac{1}{2}}$ is read 81 in the square root.

$\sqrt[3]{}$ or $^{\frac{1}{3}}$ denotes the Cube Root, &c. 3^2 means that 3 is squared, or to be multiplied, by itself.

3^3 means that 3 is to be cubed. 48^4 shows that 48 must be raised to the 4th power.

$\overline{19+3}\times9=198$ means that 19 added to 3, and the sum multiplied by 9, equal 198.

$\frac{12-\overline{2\times3}}{2}=3$ shows that 12 less the product of 2 multiplied by 3, and divided by 2 equal 3.

ARITHMETIC.

ARITHMETIC is the art and science of numbers and has for its operation four fundamental rules, viz. *Addition*, *Subtraction*, *Multiplication*, and *Division*. To understand these, it is necessary to have a perfect knowledge of our method of Numeration or Notation.

NOTATION

TEACHES to express numbers by words or characters.

When performed by means of characters or figures, ten are employed. Nine of these are of intrinsic value and are called digits, or significant figures, being written and named thus:

1 one,	4 four,	7 seven,
2 two,	5 five,	8 eight,
3 three,	6 six,	9 nine.

The tenth figure, namely, 0, is called *naught* or cipher, and denotes a want of value wherever it is found.

Besides the simple value of the digits, as noted above, they have each a local one, which depends on the following principle.

In a combination of figures, reckoning from right to left, the figure in the first place represents its simple value; that in the second place ten times its simple value; that in the third place an hundred times its simple value; and so on; each figure acquiring anew a tenfold value for every higher place it occupies. Hence our system of arithmetic is called *decimal*.

The names of places are denominated according to their order. The first is the place of units; the second of tens; the third of hundreds; the fourth of thousands; the fifth of ten thousands; the sixth of hundred thousands; the seventh of millions; and so on. Thus in the number 8888888; 8 in the first place signifies only eight; 8 in the second place eight tens or eighty; 8 in the third place eight hundred; 8 in the fourth place eight thousand;

8 in the fifth place eighty thousand; 8 in the sixth place eight hundred thousand; 8 in the seventh place eight millions. The whole number is read thus, eight millions, eight hundred and eighty-eight thousand, eight hundred and eighty-eight.

Though a cipher has no value of itself, yet it occupies a place; and when set on the right hand of other figures it increases their value in the same tenfold proportion: Thus in the number 8080; the ciphers in the first and third places denote, that though no simple unit or hundreds are reckoned, yet the place of units and that of hundreds are to be kept up to assist in reckoning the tens and thousands. The above number (8080) is read eight thousand and eighty, which, without the two ciphers, would be read eighty-eight.

Large numbers are divided into periods and half periods, each half period consisting of three figures. The name of the first period is units; of the second millions; of the third billions; of the fourth trillions; and also the first part of any period is so many units of it; and the latter part so many thousands of it.*

**EXAMPLE.*

	Trillions.		*Billions.*		*Millions.*		*Units.*	
Periods.	4.		3.		2.		1.	
Half do.	thou.	units.	thou.	units.	thou.	units.	thou.	c x.u.
Figures.	137	462	572	329	484	617	291	387

Read as follows;
One hundred and thirty-seven thousand,
Four hundred and sixty-two trillions;
Five hundred and seventy-two thousand,
Three hundred and twenty-nine billions;
Four hundred and eighty-four thousand,
Six hundred and seventeen millions;
Two hundred and ninety-one thousand,
Three hundred and eighty-seven.

NUMERATION TABLE.

9 Hundreds of Millions.
9 8 Tens of Millions.
9 8 7 Millions.
9 8 7 6 Hundreds of Thousands.
9 8 7 6 5 Tens of Thousands.
9 8 7 6 5 4 Thousands.
9 8 7 6 5 4 3 Hundreds.
9 8 7 6 5 4 3 2 Tens.
9 8 7 6 5 4 3 2 1 Units.

APPLICATION.

To express in figures Numbers which exceed Nine.

Rule.—Write down ciphers to so many places as are named in the given number; then, beginning at the left, observe at each place what significant figure is named, and, taking away the cipher, write the significant figure in its place; and thus proceed with each place till you come to the place of units.

EXAMPLES.

Twenty-five,
One hundred,
Three thousand and fifteen,
Eight hundred and twelve thousand,
Thirty-one thousand, two hundred and six,
Six millions, seven thousand and eight,
One hundred and one millions, fourteen thousand and fourteen.

To read Numbers.

Rule.—First numerate, from the right to the left hand, each figure, in its proper place, by saying, *units, tens, hundreds,* &c., as in the Numeration Table. Then, to the simple value of each figure, join the name of its place, beginning at the left hand, and reading to the right.

EXAMPLES.

64,
396,
4015,
76920,
104080,
5300648,

NOTE.—The pupil should be accustomed, in each Example, in the following Rules, to read correctly not only every answer, but every line of numbers in his sum.

ADDITION.

ADDITION in Arithmetic is the uniting or joining together of two or more numbers.

SIMPLE ADDITION is the collecting of several numbers, of the same denomination into one sum; as, 4 yards and 6 yards, expressed in one sum, are 10 yards.

Addition and Subtraction Table.

1	2	3	4	5	6	7	8	9	10	11	12
2	4	5	6	7	8	9	10	11	12	13	14
3	5	6	7	8	9	10	11	12	13	14	15
4	6	7	8	9	10	11	12	13	14	15	16
5	7	8	9	10	11	12	13	14	15	16	17
6	8	9	10	11	12	13	14	15	16	17	18
7	9	10	11	12	13	14	15	16	17	18	19
8	10	11	12	13	14	15	16	17	18	19	20
9	11	12	13	14	15	16	17	18	19	20	21
10	12	13	14	15	16	17	18	19	20	21	22

When you would add two numbers, seek one of them in the left hand column, and the other in the top line; and in the common angle of meeting, or at the right hand of the first, and under the second, you will find the sum; as, 6 and 9 are 15; and so of any others.

When you would subtract, seek, in the left hand column, the number to be subtracted from the greater; then run your eye along, in the same line, towards the right hand, till you find the number from which the other is to be taken; and exactly over this last, in the top line, you will find the difference; as, 6 from 15, and there remain 9; and so of any others.

SIMPLE ADDITION.

RULE.—Write the numbers, units under units, tens under tens, &c. and draw a line under the whole. Add up the unit column, and if the sum be less than ten, write

it under the column; if it be ten or any number of tens, write a cipher; if there be an excess over ten or tens, write down this excess, and carry as many units to the next column, as there are tens; and thus proceed with each remaining column, writing the whole sum under the last.

PROOF.—Draw a line below the upper number, and add the remaining numbers as shown in the rule; add the sum thus found and the upper number together, and if the sum be equal to the first addition, the work is right. Or begin at the top number, add downwards, and carry as before; if the two sums come alike, the work is probably right.

EXAMPLES.

1.	2.	3.
2178	567842	321674
4216	143469	92167
3945	782107	8547
2763	695213	26
1684	203169	2141
14786		
12608		
14786		

4.

X of Mill.	Millions.	C of Thous.	X of Thous.	Thousands.	Hundreds.	Tens.	Units.
9	8	7	6	5	4	3	2
4	6	5	3	2	8	1	5
9	0	0	5	4	0	6	1
3	2	7	0	0	1	0	3
	3	2	1	5	0	0	0
	9	1	3	2	0	5	1
		4	6	0	1	0	9

5.

X of Mill.	Millions.	C of thous.	X of Thous.	Thousands.	Hundreds.	Tens.	Units.
6	5	4	0	0	1	2	3
8	6	1	9	4	2	1	7
2	8	1	0	3	0	1	9
1	7	6	3	1	0	4	2
9	8	7	6	5	2	0	8
3	7	8	4	9	0	0	0
5	4	0	0	1	6	0	5

6.	7.	8.
Miles.	*Leagues.*	*Years.*
4734746	46434733	347312484
3474352	74265374	368126312
4634324	52652754	758612691
7369138	35374265	731674591
3543468	74447352	323473276
4733246	47345264	471266198
4743447	74167574	323634712
3752612	43526526	271254712
7426984	38573452	312844795

APPLICATION.

1. What is the sum of 37, 509, 7126, 17630, and 459273 yards?

2. Required, the sum of 3579, 41, 96120, 725, 11, 1820, 5, and 720139 bushels.

3. What is the sum of 2591, 720396, 14, 259, 6, 370214, 9740, 53, 1692, and 137 dollars?

4. How many days are in the 12 calendar months, in a leap year?

5. A person dying left to his widow 1500 dollars, to his eldest son 30500, to each of his other two 3406; also 2700 to each of his three daughters, besides 751 dollars in other small legacies; what did his estate amount to?

6. If the distance from Hallowell to Portland be fifty-six miles, thence to Portsmouth fifty-four miles, thence to Boston sixty-four miles, thence to Hartford ninety-eight miles, thence to New-York one hundred and eleven miles, thence to Philadelphia ninety miles, thence to Baltimore ninety-nine miles, and thence to Washington thirty-eight miles; what is the whole distance between Hallowell and the city of Washington?

7. John, James, and Paul counting their prize-money, John had one thousand, three hundred and seventy-five dollars; James had just three times as much as John: and Paul had just as much as both the others; pray how many dollars had Paul?

SIMPLE SUBTRACTION.

Subtraction is finding the difference of two numbers by taking the less from the greater. It is simple subtraction if the numbers are of one denomination; as, 5 feet taken from 8 feet, will leave 3 feet.

The greater number is called the *minuend*, or *substratum;* the less, the *subtrahend;* and the number found by the operation, the difference, or *remainder.*

Rule.—Write the less number under the greater, placing units under units, tens under tens, &c. and draw a line under them. Begin at the right, and take each figure in the subtrahend from its corresponding one in the minuend, setting down the remainder straight under it below the line. If the lower figure be greater than the one above it, add ten to the upper figure, from which sum take the lower, and set down the remainder, carrying one to the next lower figure; and thus proceed until the whole is finished.

Proof.—Add the *remainder* to the *subtrahend,* and if the sum be equal to the *minuend,* the work is right.

EXAMPLES.

1.	2.	3.
From 67216 the minuend,	46132941	71290
Take 43792 the subtrahend,	17316257	46172
23424 Remainder.		
67216 Proof.		

4.	5.	6.	7.
30421	87652176	100000	200000
10604	9107215	65321	99999

8.	9.
10000	917144043605
1	40600832164

10.	11.
100200300400	10000000
98087076065	9999991

APPLICATION.

1. From 360418 tons, take 293752.
2. From 100046 acres, take 10009.
3. What is the difference between 1735, and 1897348 hours?
4. How much do 540312 days exceed 7953?
5. How much are 30491 gallons less than 57321469?
6. If the distance from Hallowell to Savannah, through Washington, be 1268 miles and that from Washington to Savannah, 658 miles; how far is Washington from Hallowell?
7. From Hallowell to the city of New-York is 383 miles. Now, if a man should travel 10 days from Hallowell towards New-York, at the rate of thirty-six miles each day; how far would he then be from that city?
8. If a farmer kills six hogs, which weigh two hundred and fifty-four, one hundred and ninety-seven, two hundred and sixteen, two hundred and forty-nine, three hundred and twelve, and three hundred and sixty-three, and markets one thousand weight of pork; what quantity does he reserve for his own use?

SIMPLE MULTIPLICATION.

Multiplication is finding the amount of any given number, by repeating it any proposed number of times; as, 4 times 7 are 28.

The number to be multiplied is called the *multiplicand*.

The number which multiplies is called the *multiplier*.

The number arising from the operation is called the *product*.

The multiplicand and multiplier are called *factors*; and if these are of one denomination it is called Simple Multiplication.

MULTIPLICATION AND DIVISION TABLE.

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3	6	9	12	15	18	21	24	27	30	33	36
4	8	12	16	20	24	28	32	36	40	44	48
5	10	15	20	25	30	35	40	45	50	55	60
6	12	18	24	30	36	42	48	54	60	66	72
7	14	21	28	35	42	49	56	63	70	77	84
8	16	24	32	40	48	56	64	72	80	88	96
9	18	27	36	45	54	63	72	81	90	99	108
10	[illegible]	[illegible]	40	50	60	70	80	90	100	110	120
11	22	33	44	55	66	77	88	99	110	121	132
12	24	36	48	60	72	84	96	108	120	132	144

USE *of the* TABLE *in* MULTIPLICATION.

Find the multiplier in the left hand column, and the multiplicand in the uppermost line; and the product is in the common angle of meeting, or against the multiplier, and under the multiplicand.

To use the above Table in *Division*, seek your divisor in the left hand column; then run your eye along the line, to the right hand, till you come to your dividend; and the figure in the top line, of the same column, will be the quotient, or number of times the divisor is contained in the dividend.

CASE I.—*When the multiplier is not more than twelve.*

RULE.—Multiply each figure in the multiplicand by the multiplier, beginning at the right hand side, and setting down the whole of such products as are less than ten; but for such as are just equal to a certain number of tens, write down 0, and carry 1 for each ten to the next product; and for such as exceed a certain number of tens, set down the excess, and carry for the tens as before.

EXAMPLES.

1. What number is equal to 4 times 365?

Thus	2.
365 Multiplicand.	5124167
4 Multiplier.	3
Ans. 1460 Product.	

3.	4.	5.
42179416	74216	49267
5	2	6
6.	7.	8.
7689657	8912461	2674876
7	8	9
9.	10.	11.
427691	716234	567295
10	11	12

CASE II.—*When the multiplier consists of several figures.*

RULE.—Set the multiplier under the multiplicand, so that units may be under units, tens under tens, &c., then find the product for each figure in it, as in the first case, not regarding in what order the lines are found, provided the first figure in each stand straight below its respective multiplier. Add all the lines of products together in the same order as they stand, and the sum will be the whole product required.

PROOF.—Make the former multiplicand the multiplier, and the multiplier the multiplicand, and proceed as before; and the new product will be the same as before, when the work in both is right. Or, add together the figures first of one factor, and then of the other, casting out all the nines in the sums of each, as often as they amount to 9. Multiply the two remainders, if any, together, and the nines cast out of their product, will leave the same remainder as the nines cast out of the answer, when the work is right. The first remainder may be set at the left side of the cross, or X; the second at the right; that arising from their product at the top; and that arising from the answer at the bottom; if the answer be right, the top and bottom figures will be alike.

EXAMPLES.

1.			
4271	Multiplicand.	329	excess of 9s, 5
329	Multiplier.	4271	do. do. 5
38439		329	
8542		2303	
12813		658	
		1316	
1405159	Product.	Proof 1405159	excess of 9s, 7.
			7
			or 5×5
			7

2.	3.	4.
691861	129186	281216
26	98	978
17988386	12660228	275029248

5.	6.	7.
181281	281691	264648436
763	76286	3639604
138317403	21489079626	963215506259344

CONTRACTIONS IN MULTIPLICATION.

CASE I.—*When there are ciphers at the right hand of one or both of the factors.*

RULE.—Proceed as before, neglecting the ciphers, and to the right hand of the product, place as many ciphers as are in both the numbers.

EXAMPLES.

1.	2.	3.
27600	180120	27640
48000	48100	20
2208		
1104		
1324800000	8663772000	

CASE II.—*When the multiplier is the product of two or more numbers.*

RULE.—Multiply once successively by each of those numbers instead of using the whole multiplier at once.

EXAMPLES.

1.

Multiply 7629 by 63
$7 \times 9 = 63$ 7

53403
9

Prod. 480627

2.
74639 by 72

3.
46217 by 96

4.
37692 by 132

APPLICATION.

1. What will 37 horses for shipping come to, at 52 dollars per head? Ans. 1924 dols.

2. What will 587 firkins of butter come to, at 7 dollars per firkin? Ans. 4109 dols.

3. What will 367 acres of land cost, at 13 dollars per acre? Ans. 4771 dols.

4. If a barrel of pork cost 18 dollars what will 857 barrels be worth? Ans. 15426 dols.

5. What will be the worth of 924 tons of potash, if one ton sell for 95 dollars? Ans. 87780 dols.

6. A merchant having traded ten years, found he was worth 13000 pounds. His books showed that the last three years he had cleared 873 pounds a year; the three preceding but 586 pounds a year; and before that but 364 pounds a year. With what sum did he begin business? Ans. 7167 pounds.

7. Trajan's bridge over the Danube is said to have had twenty piers to support the arches, every pier being 60 feet thick, and some of them 150 feet above the bed of the river; they were also 170 feet asunder. Pray, how wide was the river in that place? and how much did this bridge exceed in length that at Westminster, in England, which is about 1200 feet from shore to shore, and is supported by 11 piers, making the number of arches 12?

Ans. { 4770 feet wide, and 3570 feet longer than Westminster bridge.

8. In the partition of lands in a certain settlement, A. had 757 acres allotted to him; B. 2104; C. 16410; D. 12881; E. 11003; F. 9813; H. 13800; and I. 8818 acres. Now as the above allotments want 416 acres to make them just one fifth of the whole, how many acres did the settlement contain? Ans. 380035 acres.

DIVISION.

Division shows how often one number is contained in another: as 24 divided by 6, produce 4 in the quotient; that is, 6 are contained 4 times in 24.

The number to be divided is called the *dividend.*

The number by which we divide is called the *divisor.*

The number of times the dividend contains the divisor is called the *quotient.*

The *remainder*, if there be any, will be less than the divisor.

It is called Simple Division, if the *dividend* and *divisor* have but one and the like name.

Rule.—On the right and left of the dividend draw a curved line, and write the divisor on the left, and the quotient as it arises on the right hand. Assume as many figures on the left hand of the dividend as contain the divisor once, or more, and place the number in the quotient. Multiply the divisor by the quotient figure, and set the product under the assumed part of the dividend; subtract it, and to the remainder bring down the next figure of the dividend; which number divide as before, and thus proceed until the whole is divided.

Note 1.—If after a figure is brought down, the number be less than the divisor, place a cipher in the quotient, and bring down the next figure of the dividend.

Note 2.—Remember, that the products of the divisor and the several quotient figures, must always be less than the parts of the dividend under which they are set, unless they chance to be just the same numbers; and that every remainder must be less than the divisor.

Proof.—To the product of the divisor and quotient, add the remainder, which sum will be equal to the dividend, if the work is right.

Or, cast the nines out of the divisor, and place the excess or remainder on the left side of a cross, or X; do the same with the quotient, and place the excess on the right hand; multiply these two figures together, add their product to the remainder of the divisor, if there be any, cast out the nines in the sum, and set the excess at the top of the cross; cast the nines out of the dividend, and place the excess at the bottom; then, if the top and bottom figures are alike, the work is right.

EXAMPLES.

1.

Divis. Divid. Quot.
48)7641312(159194
48
———
284
240
———
441
432
———
93
48
———
451
432
———
192
192

159194
48
———
1273552
636776
———
7641312 Proof.

Proof by excess of nines.
6
3×2
6

2.

Divis. Divid. Quot.
5)172164(34432$\frac{4}{5}$
15
———
22
20
———
21
20
———
16
15
———
14
10
———
4 Remainder.

Proof.
3
5×7
3

5×7=35
add 4 rem.
———
39

NOTE.—If there be no remainder, the quotient is the perfect answer to the question; but if there is, to complete the quotient, put the remainder at the end of it, and the divisor below it, drawing a line between the two.

				Quotient.	Rem.
3.	Divide 153598	by	29	Ans. 5296	and 14
4.	301147		63	4780	7
5.	138317403		763	181281	0
6.	11214887		232	48340	7
7.	4678216		400	11695	216
8.	1030603615		3215		0
9.	4917968967		2359		1255
10.	210634711		6000		4711

CONTRACTIONS.

CASE I.—When there are ciphers at the right hand of the divisor, cut them off; likewise cut off the same number of digits from the right hand of the dividend; then divide as usual, and to the remainder annex the digits cut off from the dividend.

EXAMPLES.

1.

```
342,00)6792,16(19
       342
       ----
       3372
       3078
       -----
       29416 Remainder.
```

2.

```
135,000)27619,413(
        -----
        ------
        79413 Rem.
```

CASE II.—*When the divisor is any number not exceeding* 12.

RULE.—First seek how often the divisor can be had in the first figure, or figures, of the dividend; put the result under the dividend; multiply this quotient figure and the divisor together; *mentally* subtract their product from the part of the dividend taken; what remains call so many tens, which place, in idea, before the next figure of the dividend for a new dividual; and so proceed through the whole dividend. When, in subtracting, nothing remains, take the next figure; if that be less than the divisor, take the next two, and place a cipher under the first.

1.

```
6)7241324(
  --------
Quotient 1206887 2/6 Rem.
```

2.

```
5)172164(
  -------
Quotient 34432 4/5 Rem.
```

3.	Divide 3764592	by	7
4.	527684		8
5.	1410217		9
6.	612948		11
7.	317926		12

CASE III.—If the divisor be a product of two or more numbers divide continually by those numbers instead of the whole at once.

EXAMPLES.

1.

Divide 7621460 by 16

```
4)7621460
 --------
4)1905365
 --------
Quo. 476341—4 Rem.
```

2.

4792161 by 48

```
6)4792161
 --------
8)      —3
 --------
99836—5×6+3=33
```

NOTE.—It sometimes happens that there is a remainder to each of the quotients, and neither of them the true one, but the true remainder may be found by the following rule.

RULE.—Multiply the last remainder by the last divisor but one, and to the product add the preceding remainder; multiply this sum by the next preceding divisor, and to this product add the next preceding remainder, and so on until all the remainders and divisors are used; and the last sum will be the true remainder.

3.

Divide 6421671 by 448

```
8×8×7=448   8)6421671
              -------
              8)802708—7
              -------
              7)100338—4
Quotient.   14334—4×8+7=39 Remainder.
```

4.

Divide 27162 by 62

APPLICATION.

1. Divide 3656 dollars equally among 8 men.
Ans. 457 dols. to each.

2. There are 124 men who have 372 dollars among them; how much is one man's share, if it be divided equally? Ans. 3 dols.

3. If I wish to perform a journey of 3264 miles in 136 days, how far must I travel each day to complete it?
Ans. 24 miles.

4. A payment of 1272 dollars was made by a number of men, each of whom paid 3 dollars; how many men were there? Ans. 424.

5. I would plant 2072 trees, in 14 rows, 25 feet asunder; how long must the grove be? Ans. 3675 feet.

6. Divide 1000 dollars, between A, B, and C, and give A 129 more than B, and B 178 less than C.

Ans. 369 dols. A's, 231 B's, and 409 C's.

7. Part 1500 acres of land between Saul, Seth, and Silas; and give Seth 72 more than Saul, and Silas 112 more than Seth. Ans. { $414\frac{2}{3}$ Saul's share, $486\frac{2}{3}$ Seth's, and $598\frac{2}{3}$ Silas's.

8. A brigade of horse consisting of 384 men, is to be formed into a column, having 32 men in front; how many ranks will there be? Ans. 12.

9. In order to raise a joint stock of 10,000 dols. L, M, and N, together, subscribe 8500, and O, the rest. Now, M and N are known, together, to have set their hands to 6050, and N has been heard to say that he had undertaken for 420 more than M. What did each proprietor advance?

Ans. L, 2450, M, 2815, N, 3235, and O, 1500.

PRACTICAL QUESTIONS

UNDER THE PRECEDING RULES.

1. Add fourteen thousand, five hundred and nine; one thousand, nine hundred and twenty-one; six hundred and twenty thousand, three hundred and forty-seven; and five million, twenty-three thousand, and nineteen, together.

Ans. 5659796, sum.

2. What is the sum of 76129+54216+39127+62357+514026? Ans. 745855.

3. What is the difference between four million two hundred and ten thousand and twelve; and six hundred and fifty-nine thousand seven hundred and ninety-seven?

Ans. 3550215.

4. Take nine hundred and one thousand and fifteen, from one million, one thousand, one hundred and one?

Ans. 100086.

5. A farm of 460 acres is let for 2 dollars per acre; how much does the rent amount to? Ans. 920 dols.

6. If a man's income be 6 dollars a day, how much does it amount to in a year, allowing 365 days in a year?

Ans. 2190 dollars.

7. What is the product of 376×54? Ans. 20304.

8. 64 men have 17280 dollars divided equally among them; what is each man's part? Ans. 270 dollars.

9. Multiply three hundred and seventy-eight thousand and five hundred, by thirty-four. Ans. 12869000 product.

10. What is the third part of 3669? Ans. 1223.

11. Divide 6764 by 19. Ans. 356 quotient.

12. What number must be added to 764 to make it 1256? Ans. 492.

13. By what number must I multiply 67, that the product may be 871? Ans. 13.

14. There are two numbers whose difference is 796, the greater number is 4320; I demand the less.

Ans. 3524.

15. Supposing a man to have been born in the year 1762; how old was he in 1806? Ans. 44.

16. Suppose a man to have been 78 years old in the year 1806; in what year was he born? Ans. 1728.

17. What will 12 tons of hay come to at 27 dollars per ton? Ans. 324 dollars.

18. What will 750 barrels of beef come to at 11 dollars per barrel; and what will the profits amount to in selling it, if I clear 3 dollars on each barrel?

Ans. { 8250 dollars amount.
2250 dollars profit.

19. There is a town which contains 290 houses, and each house 6 inhabitants; how many inhabitants are there in that town? Ans. 1740.

20. A prize of 48726 dollars is owned by 270 men; what is each man's share? Ans. $180\frac{21}{45}$ dollars.

21. If 12 bundles of wheat produce 1 bushel, how many bushels will 4764 bundles produce? Ans. 397 bushels.

22. Borrowed of A, 12 sums of money, each 250 dollars; paid him at one time 97 dollars, and at another 35; the balance I am to pay him in six equal payments; what is one of those payments? Ans. 478 dollars.

TABLES

OF MONEY, WEIGHTS, AND MEASURES.

1. Money.*

4 Farthings make one penny; *qr. d.* denote farthings and pence respectively.

12	Pence make one shilling	- - *s.* - -		*Shilling.*
20	Shillings 1 pound	- - - £ - -		*Pound.*

¼ Is one farthing, or one fourth; ½ is one halfpenny, or one half; ¾ three farthings, or three fourths.

2. Troy Weight.

24	Grains make one pennyweight, marked			*grs. dwt.*
20	Pennyweights - -	1 Ounce,	- - -	*oz.*
12	Ounces - - -	1 Pound,	-	℔. or *lb.*

By this weight are weighed jewels, gold, silver, electuaries and liquors.

3. Apothecaries' Weight.

20	Grains make -	1	Scruple, marked *gr.*	℈, or *scr.*
3	Scruples - -	1	Dram, - - - -	ʒ, or *dr.*
8	Drams - - -	1	Ounce, - - - -	℥, or *oz.*
12	Ounces - - -	1	Pound, - - - -	℔, or *lb.*

Apothecaries use this weight in compounding their medicines, but they buy and sell their drugs by Avoirdupois weight.

* Sterling money was, formerly, of the same value in all the Colonies of North-America. By reason, however, of the emission of paper money by the Legislatures of those Colonies, which afterwards depreciated, the Spanish *dollar* came to be reckoned, in different Colonies, at a higher or lower value, accordingly to the less or greater depreciation of their paper currencies. Still, though the *pound* was valued accordingly to this paper medium, it was, in every Colony, reckoned at *twenty* shillings, as in England. Thus, a Spanish dollar being worth 4*s.* 6*d.* in England, became, in Georgia and South Carolina, where the depreciation of the paper was least worth 4s. 8d.; in Canada and Nova-Scotia, where it was somewhat greater, 5s.; in New-England, Virginia, Kentucky, and Tennessee, 6s.; in New-Jersey, Pennsylvania, Delaware and Maryland 7s. 6d.; and in New-York, and North-Carolina, 8s.

4. Avoirdupois Weight.

16 Drams make	1 Ounce, marked,	- -	dr. oz.
16 Ounces	1 Pound,	- -	℔ or lb.
28 Pounds*	1 Quarter,	- - - - - - -	qr.
4 Quarters	1 Hundred weight,	-	cwt.
20 Hundred wt.	1 Ton,	- - - - - - -	T.

By a late law of this state, 25 ℔ make a qr.

By this weight are weighed all things of a coarse nature; such as leather, cheese, grocery wares, bread, and all metals except gold and silver. It is our common steelyard weight.†

Note.—5760 grains=1 ℔. Troy; 7000 grains=1 ℔. Avoirdupois; therefore the weight of a pound Troy, is to a pound Avoirdupois as 5760 to 7000, or as 144 to 175.

5. Cloth Measure.

4 Nails, or 9 inches, make	1 Quarter, marked,	na. qr.
4 Quarters	1 Yard,	yd.
3 Quarters	1 Ell Flemish,	E. Fl.
5 Quarters	1 Ell English,	E. E.
6 Quarters	1 Ell French,	E. Fr.

Note.—We buy Scotch and Irish linens by our American yard, and Dutch linens by the ell Flemish; but we sell them here by the same measure, the yard.

* Most of the merchants and traders in the United States, now call 25 lbs. only, a quarter of a cwt.

† A Firkin of Butter is	56 lb.	A Quintal of Fish	112lb.
A Firkin of Soap	64	A stone of Iron	14
A Barrel of Beef	220	A Gallon of Train Oil	7½
Pork	220	20 Things make	1 Score.
Potashes	400	12 do.	1 Dozen.
Soap	256	12 Dozen	1 Gross.
Butter	224	144 do.	1 Great Gross.
Flour	196	A Quire of Paper	24 Sheets.
Gunpowder	112	A Ream of Paper	20 Quires.
Raisins	112	A Bale of Paper	10 Reams.
Fish	30 gallons	A Roll of Parchment	60 Skins.

Hoops and Staves are now reckoned five scores to the hundred in this State, by a late law.

A ton in weight for Ships is 2000 lb.

A ton for goods, boxes, cases, &c. is 40 cubic feet.

6. Long Measure.

3	Barley Corns make	1 Inch, marked	*Bar. In.*
12	Inches - -	1 Foot, - - -	*Ft.*
3	Feet - - -	1 Yard, - - -	*Yd.*
$5\frac{1}{2}$	Yards, or $16\frac{1}{2}$ Feet	1 Pole, Rod or Perch,	*Rod.*
40	Poles or Rods	1 Furlong, - - -	*Fur.*
8	Furlongs - - -	1 Mile, - - -	*Mi.*
3	Miles - -	1 League, - - -	*Lea.*
60	Geographical, or	1 Degree, - -	*Deg.*
$69\frac{1}{2}$	Statute Miles		

360 Degrees make the circumference of the Earth.

By this measure distances are measured.

66 feet, or 4 rods, make a Gunter's chain, containing, 100 links, each of which is 7 $\frac{92}{100}$ inches.

6 feet make a fathom, in measuring depths.

5 feet make a geometrical pace.

4 inches make a hand, in measuring the height of horses. 6ft. $4\frac{3}{4}$in. = a French toise.

1 French *post* = 2 Fr. Leagues = $5\frac{52}{100}$ Eng. miles.

1 German short mile = $3\frac{896}{1000}$ Eng. miles.

1 Eng. mile = $1\frac{1}{2}$ + Russian *verst*.

7. Land or Square Measure.

144	Square inches make	1 Square Foot, marked	*In. Ft.*
9	Feet - -	1 Yard, - - -	*Yd.*
$30\frac{1}{4}$	Yards or	1 Rod, Pole or Perch,	*Rod.*
$272\frac{1}{4}$	Feet - -		
40	Rods - -	1 Rood or $\frac{1}{4}$ of an acre,	*Rood.*
4	Roods - - -	1 Acre, - -	*Ac.*
640	Acres - - -	1 Mile, - -	*Mi.*

By this measure, surfaces are measured. It is long measure squared, or multiplied into itself.

8. Cubic or Solid Measure.

1728	Solid Inches make	1 Foot, marked	*In. Ft.*
27	Feet	1 Yard,	*Yd.*
50	Feet of hewn, or	1 Ton or Load,	*T.*
40	Feet of round Timber		
128	Feet, *i. e.* 8 feet in length,	1 Cord of Wood,	*Cor.*
4	in breadth and 4 in height		

By this measure the contents of solids are obtained, or things that have length, breadth, and depth. It is long measure cubed, or multiplied by itself, twice.

9. Dry Measure.

2 Pints make	- -	1 Quart, marked	*Pt. Qt.*
4 Quarts	- - -	1 Gallon, - -	*Gal.*
2 Gallons	- -	1 Peck, - -	*Pk.*
4 Pecks	- -	1 Bushel, - -	*Bus.*
8 Bushels	- -	1 Quarter, -	*Qr.*
36 Bushels	- - -	1 Chaldron, - -	*Chal.*

8 Bushels a Hogshead of Salt.

Note.—The diameter of the Winchester or common bushel is 18½ inches, and its depth 8 inches.

The gallon dry measure contains 268⅘ cubic inches.

Corn, grain, beans, peas, flax-seed, salt, coals, &c. are measured by striked measure; but pears, apples, turnips, potatoes, onions, &c. are heaped to a handsome rounding measure. The bushel contains 2150⅖+cubic inches.

10. Wine Measure.

4 Gills make	- -	1 Pint, marked -	*Gill. Pt.*
2 Pints	- -	1 Quart, - -	*Qt.*
4 Quarts	- -	1 Gallon, - -	*Gal.*
42 Gallons	- -	1 Tierce, - -	*Tier.*
63 Gallons	- -	1 Hogshead, - -	*Hhd.*
84 Gallons	- -	1 Puncheon, -	*Punch.*
2 Hogsheads	- -	1 Pipe or Butt, -	*Pipe.*
2 Pipes or 4 Hhds.	-	1 Tun, - -	*Tun.*

Note.—The wine gallon contains 231 cubic inches.

The hogshead of 63 gallons, and the puncheon of 84 gallons, are not used with us. The hogshead of 108 or 110 gallons is called a hogshead or a puncheon. Brandies, spirits, perry, cider, vinegar, mead, oil and honey, are sold by this measure, though honey is sometimes sold by the pound avoirdupois. Milk is sometimes measured by this measure, though more commonly and justly by beer measure.

11. Ale Measure.

2 Pints make	-	1 Quart, marked	*Pt. Qt.*
4 Quarts	- -	1 Gallon, - -	*Gal.*
8 Gallons	-	1 Firkin of Ale,	*A. Fir.*
9 Gallons	- -	1 Firkin of Beer,	*B. Fir.*
36 Gallons	-	1 Barrel of Beer, -	*Bar.*
54 Gallons	- -	1 Hogshead, - -	*Hhd.*
3 Barrels	-	1 Butt, - -	*Butt.*

Note.—The Ale gallon contains 282 cubic inches.

Milk is sold by the Beer quart, which is about one sixth larger than the wine, cider, &c. quart. 32 gal.=1 bar. ale.

12. Time.

60 Seconds make	1 Minute, marked	S.	M.
60 Minutes	1 Hour,		H.
24 Hours	1 Day,		D.
7 Days	1 Week,		W.
4 Weeks	1 Month,		Mo.
13 Lunar or 12 Solar months or 365 Days	1 Year,		Y.

Note.—365 days, 5 hours, 48 minutes, 48 seconds, make a solar year according to the most exact observation.

April, June, September and November, have each 30 days; each of the other months has 31, except February, which has 28 in common years and 29 in leap years.*

30 years make an age, and 100 years a century.

A lunar month is 29d. 12h. 44m. 3s. nearly.

13. Circular Motion.

60 Seconds make	1 Prime minute, marked	′″
60 Minutes	1 Degree,	°
30 Degrees	1 Sign,	S.
12 Signs, or 360 Degrees	The whole circle of the Zodic.	

* *To find whether any given year will be leap year.*

Rule.—Divide the given year by 4; if nothing remain, it is leap year; but if there be a remainder, *that* is the number of years after leap year.

Example.

Was 1823 leap year? 4)1823

455-3 rem.

which shows it to have been the 3d after leap year.

The last year in every three centuries out of four, which would otherwise be leap year, is to be reduced to a common year.

To find whether the last year in any given century is leap year.

Rule.—Divide the given century only, or the hundreds in the year, by 4; if nothing remain, it is leap year; but a remainder shows it is to be counted a common year.

Example.

Will the year 1900 be leap year?

4)19(4
16

3 remainder; therefore a common year.

REDUCTION.

Reduction teaches to change the denomination of numbers without altering their value.

Rule.—When the reduction is from a higher denomination, to a lower, as pounds into shillings, tons into ounces, &c. multiply the highest denomination by as many of the next lower as make one of the highest, adding to the product the parts of the same name; multiply this sum by the next lower, adding to the product the parts of its own name, if any; and so on to the denomination required.

When the reduction is from a lower to a higher denomination, pence into pounds, minutes into days, &c. divide the given number by as many of that denomination as make one of the next higher, and so on, to the denomination required; and the last quotient with the several remainders, (if any) will be the answer required.

The proof is had by reversing the question.

EXAMPLE.

MONEY.

1. In 476 pounds, how many shillings and pence?

```
      476
       20
      ---
     9520 Shillings.
       12          12)114240
     ------        ---------
Ans. 114240 Pence.  2,0)952,0
                    ---------
                  Proof, 476
```

2. In 3694 shillings, how many pence? Ans. 44328.
3. How many farthings in 69217 pence? Ans. 276868.
4. Reduce 6942 pounds to farthings. Ans. 6664320.

5. In £49 19s. 11¾d. how many farthings?

£.	s.	d.	qr.
49	19	11	3

20

999 Shillings,
12

11999 Pence.
4

Ans. 47999 Farthings.

6. How many Pence in £472 13s. 4d.?

Ans. 113440.

7. How many pounds in 467216 farthings?

4)467216

12)116804

2,0)973,3 8d.

Ans. £486 13s. 8d.

8. How many pounds in 9752 pence?

Ans. £40 12s. 8d.

9. In 648 English guineas,* how many pence?

Ans. 217728.

* TABLE,

Showing the weight and value of several pieces of Foreign Coins.

				£	s.	d.		$	cts.
An English Shilling is			-		1	4	or		22 2/9
A French Franc,			- -		1	1½			18¾
A Livre Tournois,			- -		1	1⅓			18¼
An English or French Crown,					6	7 1/5		1	10
Napoleon,	4 *dwt.*	6 *grs.*	-	1	2	3		3	71
½ Johannes,	9		- -	2	8	0		8	00
Moidore,	6	18	-	1	16	0		6	00
Eng. Guinea,	5	6	-	1	8	0		4	66⅔
French do.	5	5	- -	1	7	3¼		4	54½
Sp. Pistole,	4	5	- -	1	1	3		3	54⅓

By an act of Congress, passed April 29th, 1816, the gold coins of Great Britain and Portugal, are estimated at 27 grains to the dollar; those of France, at 27½ grains to the dollar; and those of Spain and her dominions, at 28½ grains to the dollar.

10. How many Eng. guineas in 28560 pence? Ans. 85.

11. In 37 Spanish pistoles, how many farthings?
Ans. 37740.

12. In 48960 farthings, how many pence, three-pences, six-pences and dollars? Ans. 12240 pence, 4080 three-pences, 2040 six-pences, and 170 dollars.

13. In 427 moidores, how many dollars and pounds?
Ans. $2562, or £768 12*s.*

14. In 11040 pence, how many dollars? Ans. $153 2*s.*

15. How many pounds in 91751 farthings?
Ans. £95 11*s.* 5¾*d.*

TROY WEIGHT.

1. How many grains in 47℔. 10*oz.* of gold?
Ans. 275520.

2. In 47128 grains of gold, how many pounds?
Ans. 8℔. 2*oz.* 3*dwt.* 16 *grs.*

3. In 5605 grains, how many ounces?
Ans. 11*oz.* 13*dwt.* 13*grs.*

4. How many grains in 18℔. 5*oz.* 9*dwt.* 21 *grs.*
Ans. 106317*grs.*

AVOIRDUPOIS WEIGHT.

1. In 12*cwt.* 1*qr.* 18℔. how many ounces, at 25℔. to the qr. of a cwt? Ans. 19688.

2. How many tons in 3440640 drams? Ans. 6 *Tons.*

3. In 2*T.* 15*cwt.* 2*qrs.* 17℔. how many pounds at 25℔. to the quarter? Ans. 5567℔.

4. How many pieces of 4℔. 5½℔. and 6½℔. of each an equal number, in 62*cwt.* 2*qrs.* 24℔. of beef?
Ans. 439 pieces of each.

5. In 3 tons of hay, how many pounds? Ans. 6720℔.

APOTHECARIES' WEIGHT.

1. In 31℔. 2℥. 6ʒ. how many drams. Ans. 2998.

2. How many pounds in 2535 scruples?
Ans. 8℔. 9℥. 5ʒ.

CLOTH MEASURE.

1. How many quarters in 83*yds.* 3*qrs.*? Ans. 335.

2. In 2528 nails, how many yards? Ans. 158.

3. In 840 nails, how many ells English? Ans. 42.

4. How many yards of Holland in 58 pieces, each containing 36 ells Flemish? Ans. 1566.

5. In 748 ells French, how many ells English, ells Flemish, yards, quarters, and nails? Ans. 897 *E. E.* 3 *qrs.*—1496 *E. Fl.*—1122 *yds.*—4488 *qrs.*—17952 *na.*

LONG MEASURE.

1. In 70 miles, how many furlongs and poles?
Ans. 560 *fur.* 22400 *poles.*

2. How many leagues in 21120 yards? Ans. 4.

3. How many barley corns in 360 degrees, each degree 69½ miles? Ans. 4755801600.

4. How often will a wheel that is 15 feet in circumference, turn round in the distance from Hallowell to Farmington, it being 32 miles? Ans. 11264.

LAND OR SQUARE MEASURE.

1. In 17 acres 3 roods, 10 poles, how many poles?
Ans. 2850.

2. In 815443200 inches, how many acres? Ans. 130.

3. How many acres in 6654 rods or poles?
Ans. 41 *Acres*, 2 *Roods*, 14 *Rods.*

4. In 6 acres, 1 rood, how many perches? Ans. 1000.

5. If a room be 16 feet long, and 14 feet wide, how many feet of boards will it take to lay the floor?
Ans. 224 feet.

6. How many shingles will it take to cover the roof of a house 40 feet in length, and of 18 feet rafters, allowing each shingle to be 4 inches wide, and each course to be laid out 6 inches? Ans. 8640.

7. How many boards will cover a barn that is 50 feet long, and 30 feet wide; the height of the gable ends 13 feet, and the rafters 20 feet each; and the posts, or body of the frame, 15 feet in height? Ans. 4790 feet.

CUBIC OR SOLID MEASURE.

1. In 9 tons of round timber, how many inches?
Ans. 622080.

2. How many cords of wood in 3096576 inches?
Ans. 14.

3. In 259200 inches of hewn timber, how many tons?
Ans. 3.

4. How many bricks, 8 inches long, 4 wide, and 2 thick, will build a house 44 feet long, 40 feet wide, and 20 feet high, with walls 12 inches thick? Ans. 88560.

DRY MEASURE.

1. In 49 bushels, how many quarts? Ans. 1568.

2. How many bushels in 27072 quarts? Ans. 846.

3. How many pints in 150 bushels of corn? Ans. 9600.

4. In 56 bushels of wheat, Canada measure, how many bushels of the United States? Ans. 70.

NOTE.—5 pecks, or 40 quarts, make 1 Canada bushel.

WINE MEASURE.

1. In 3 hogsheads, how many gills? Ans. 6048.

2. How many hogsheads in 6480 gills?
Ans. 3 *Hhds.* 13 *Gals.* 2 *Qts.*

3. How many pints in 25 tuns of wine? Ans. 50400.

4. In 30876 gills, how many hogsheads?
Ans. 15 *Hhds.* 19 *Gals.* 3 *Qts.* 1 *Pt.*

BEER MEASURE.

1. In 10 hogsheads 17 gallons, how many gills?
Ans. 17824.

2. How many firkins of ale, in 7624892 pints?
Ans. 119138 *A. Fir.* 7 *Gals.* 2 *Qts.*

3. How many pints in 12 hogsheads, 15 gallons, 2 quarts? Ans. 5308.

4. In 6420 quarts, how many firkins of Beer?
Ans. 178 *B. Fir.* 3 *Gals.*

TIME.

1. How many minutes in 347 days? Ans. 499680.

2. In 57953 hours, how many weeks?
Ans. 344 *W.* 6 *D.* 17 *H.*

3. How many seconds are there in 72 years, 10 days, 18 hours, 11 minutes, allowing 365 days and 6 hours to a year? Ans. 2273076660.

4. How many days from the 26th of April to the 16th of December following? Ans. 240.

5. Suppose your age to be 16 years and 20 days, how many seconds old are you, allowing 365 days and 6 hours to the year? Ans. 506649600 *Sec.*

6. How many days from the birth of Christ, to Christmas 1823, allowing the year to contain $365\frac{1}{4}$ days?
Ans. $665850\frac{3}{4}$ *Days.*

7. In a lunar month, how many seconds?
Ans. 2551443 *Seconds.*

CIRCULAR MOTION.

1. In 6 signs of the zodiac, through which the sun moves in half a year, how many seconds?

Ans. 648000.

2. How many prime minutes in 360 degrees?

Ans. 21600.

APPLICATION.

1. Four men brought each £70 sterling value in gold into the mint; how many guineas at 21s. each must they receive in return? Ans. 266 guin. 14s.

2. A silversmith received 3 ingots of silver each weighing 54 ounces, with directions to make them into spoons of 2 oz., cups of 5 oz., salts of 1 oz., and snuff boxes of 2 oz., and deliver an equal number of each; what was the number? Ans. 16 of each, and 2 oz. over.

3. Suppose a ship's cargo from Bourdeaux to consist of 250 pipes, 130 hhds. and 150 quarter casks or $\frac{1}{2}$ hhds.; how many gallons are there in all; and, allowing every pint to be a pound, what burden was the ship of?

Ans. 44415 gal., and the ship's burden was 158 tons 12 cwt. 2 qrs.

4. In 15 pieces of cloth, each piece 20 yds. how many French ells? Ans. 200.

5. In 10 bales of cloth, each bale 12 pieces, and each piece 25 Flemish ells, how many yards? Ans. 2250.

6. The forward wheels of a waggon are 14$\frac{1}{2}$ feet in circumference, and the hind wheels 15 feet, 9 inches; how many more times will the forward wheels turn round than the hind wheels, in running from Hallowell to Boston, it being 174 miles? Ans. 5028$\frac{4}{7}$ times.

7. How many times will a ship 97 feet, 6 inches long, sail her length, in the distance of 12800 leagues, and 10 yards? Ans. 2079508.

8. The sun's mean distance from the earth is 95,000,000 of miles; and a cannon ball at its first discharge, flies about a mile in 7$\frac{1}{2}$ seconds; how long would a cannon ball be, at that rate, in flying from the earth to the sun?

Ans. 22yrs. 216days, 12h. 40min.

9. If a field be 36 rods long, and 24 rods wide, how many acres does it contain? Ans. 5 ac. 1 rood, 24 rods.

10. How many strokes does a regular clock strike in 365 days or a year? Ans. 56940.

11. How long will it take to count a million, at the rate of 50 a minute? Ans. 333h. 20m. or 13d. 21h. 20m.

12. If the national debt of England amounts to 837 millions of pounds sterling; how long would it take to count this debt in dollars, (4s. 6d. sterling,) reckoning, without intermission, twelve hours a day, at the rate of 50 dollars a minute; and allowing 365 days to the year?
Ans. 283 yrs. 38 days 4 hours.

13. In 42 pigs of lead, each weighing 4cwt. 3qrs. how many fother, at 19cwt. 2qr? *Ans.* 10 fother, 4½ cwt.

14. A gentleman has 20 hhds. of tobacco, each 8 cwt. 3 qrs. 14℔, and wishes to put it into boxes containing 70 lb. each; I demand the number of boxes he must get, at 25℔ to the qr.? *Ans.* 254.

15. How many coats can be made out of 86¾ yds. of broadcloth, allowing 1¾ yds. for a coat? *Ans.* 21.

16. *A* man would ship 720 bushels of corn, in barrels which will hold 3 bus. 3 pks. each; how many barrels must he get? *Ans.* 192.

17. How many pints, quarts, and two quarts, of each an equal number, may be filled from a pipe of wine?
Ans. 144.

18. Three fields contain, the first 7 acres, the second 10 acres, and the third 12 acres, 1 rood; how many shares can they be divided into, each share to contain 76 perches?
Ans. 61 shares, and 44 perches over.

FEDERAL MONEY.*

The denominations of Federal Money, like figures in whole numbers, increase in a tenfold proportion, begining with mills, of which

10 make	-	1 Cent,	marked *m. c.* respectively.	
10 Cents	-	1 Dime,	- -	*d.*
10 Dimes	-	1 Dollar,	- -	*Doll. or $.*
10 Dollars		1 Eagle,	- - -	*E.*

* Federal Money ought, in strict propriety, to be treated of after decimal fractions; but usefulness, (as fractions are not always un-

In the money of account the dollar is considered as the unit; all other denominations being valued according to their distance from the dollar's place. A point or comma must be placed after the dollars to separate them from the lower denominations; then the first figure at the right of the comma is dimes, the second cents, and the third mills; but in reckoning, the two first are called so many cents, using the dimes for the tens' place of cents.* When the cents in any sum are less than 10, a cipher must be put in the place of dimes, or tens' place of the cents, before any operation is performed.

ADDITION OF FEDERAL MONEY.

Rule.—Place the numbers according to their value, dollars under dollars, cents under cents, &c. and add as in whole numbers, placing the comma in the sum directly under the commas above.

derstood) requires, and its simplicity and near alliance to whole numbers, will admit it in this place.

The coins of the United States are three of gold, six of silver and two of copper. The gold coins are called an eagle, half eagle and quarter eagle; the silver, a dollar, half dollar, quarter dollar, double dime, dime and half dime; and the copper, a cent and half cent.

The weight of the eagle is 11 pennyweights and 6 grains; the weight of the dollar 17 pennyweights 8 grains; of the dime, 1 pennyweight 17 3-5 grains; of the cent 8 pennyweights 16 grains. The standard for gold coin is eleven parts fine gold and one part alloy; the alloy consisting of silver and copper. The standard for silver is 1485 to 179 alloy; the alloy being wholly of copper. Alloy is used in gold or silver to harden it.

When either gold or silver is finer or coarser than the standard, the variation from the standard is estimated by carats and grains of a carat in gold, and by pennyweights in silver.

Note.—A carat is not any certain *quantity* or *weight*, but $\frac{1}{24}$ of any weight or quantity; which minters and goldsmiths divide into four equal parts called *grains* of a carat.

* Any sum of this money may be read differently; either wholly in the lowest denomination, or partly in the higher and partly in the lowest. Thus the sum of $24,367 may be read 24367 mills; or 2436 cents, 7 mills; or 243 dimes, 6 cents and 7 mills; or 24 dollars, 3 dimes, 6 cents and 7 mills; or 2 eagles, 4 dollars, 3 dimes, 6 cents and 7 mills; or 24 dollars, 36 cents and 7 mills; but the last is the usual method.

EXAMPLES.

	1.	2.	3.
	$ c. m.	$ c. m.	$ c. m.
	4612,39 4	274,62 1	489,20 6
	5746,29 6	125,48 6	217,16 5
	6154,34 7	612,59 4	6,74 9
	2410,61 8	431,51 3	12,81 6
	3917,46 5	246,34 9	7,10
Sum.	22841,12 0		
	18228,72 6		
Proof.	22841,12 0		

4.	5.	6.
$. c.	$. c. m.	$. c.
3792,47$\frac{1}{2}$	76,28 1	180,20
684,16	39,46 2	29,
59,76	57,19 7	6,17
1246,28$\frac{3}{4}$	68,49 8	31,42

APPLICATION.

1. Suppose that B owes A $75, 17c. ; C owes 15c. 4m. ; D owes $21, 13c. 6m. ; E owes 9c. ; F owes $796, 3c. ; and G owes $17,13c. ; what is due to A from all of them ?

Ans. $909, 71c.

2. There is a gallant ship just returned from the Indies, which is herself worth $12145,86c. ; and one quarter of her cargo is valued at $25411,65c. ; pray tell me the value of the ship and cargo.

Ans. $113792,46c.

SUBTRACTION OF FEDERAL MONEY.

Rule.—Place the less sum under the greater in the same manner as in addition. Subtract as in whole numbers, and place the comma directly under those above.

EXAMPLES.

	1.	2.	3.
	\$ c. m.	\$ c.	\$ c. m.
From	4612,60 5	41,20	317,61 1
Take	2904,71 6	3,97	149,72 1
Rem.	1707,88 9		
Proof	4612,60 5		

4.	5.	6.
\$ c. m.	\$ c.	\$ c.
2910,70 2	392,47	2000,
827,06 4	176,89	246,28

APPLICATION.

1. Suppose that my rent for three months is \$268, and that I have paid for taxes \$58,16c., and for several repairs \$73,85½c. ;—what have I to pay of my quarter's rent? Ans. \$135,98½c.

2. Jack Hatchway received prize money to the amount of \$1000; he then laid out \$411,41c. for a span of fine horses; \$123,40c. for a suit of new clothes and a gold watch; and \$359,50c. were lost in lottery gambling;—what will he have left, after he has paid his landlord's bill, which is \$85,11c.? Ans. \$20,58c.

MULTIPLICATION OF FEDERAL MONEY.

Rule.—Multiply as in whole numbers, and place the comma as many figures from the right hand in the product as it is in the multiplicand.

EXAMPLES.

	1.	2.
	\$ c.	\$ c. m.
Multiplicand,	4769,67	4276,96 7
Multiplier,	36	48
	2861802	
	1430901	
Product,	171708,12	205294,41 6

		$ c. m.				$ c. m.
3.	Multiply	67,48 2	by	5	Product,	337,41 0
4.		76,43		4		305,72
5.		3,16 4		9		28,47 6
6.		,78 1		12		9,37 2
7.		1,06		45		47,70
8.		3,16		150		474,00
9.		4,25		598		2541,50
10.		4,96 3		347		1722,16 1

NOTE.—To multiply by $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, &c. Take $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, &c. of the multiplicand first, and set it down beneath the line as a product; then multiply by the whole number, setting the product or products below that of the fraction, and add all together.

11.	Multiply	10,50	by	$14\frac{1}{2}$	Product,	152,25
12.		1,20		$84\frac{1}{4}$		101,10
13.		2,40		$26\frac{3}{4}$		64,20

APPLICATION.

1. What will 120 yards of damask come to, at $12,5c. per yard? *Ans.* $1446.

2. Find the amount of the following Bill of Parcels.

Hallowell, Nov. 1, 1832.

Mr. Peter Paywell,

Bought of Francis Fairdealer;

		$	c.
28 ℔. of Green Tea, at $2,15c. per ℔.			
41 ℔. of Coffee,	0,15		
34 ℔. of Loaf Sugar,	0,19		
13 cwt. of Malaga Raisins,	7,31 per cwt.		
35 firkins of Butter,	7,14 per firkin,		
27 pairs of Worsted Hose,	1,04 per pair,		
94 bushels of Oats,	0,33 per bushel,		
29 pairs of Men's Shoes,	1,12 per pair,		

Amount,—$509,32c.

Received payment in full,

Francis Fairdealer.

A SHORT RULE

To know, mentally, the value of 100 *pounds of any article in Federal Money, when the price of* 1 *lb. is given.*

RULE.—Call the cents in the price of 1 pound, dollars, and *that* sum will be the value of 100 pounds of the arti-

cle. If there be several hundred pounds of it, multiply the value of 100℔. thus found, by the number of hundreds, and you will have the answer accordingly. The whole may be done by a single glance of the mind. Parts of a cent in the price of 1 pound, will be the same parts of a dollar in the price of 100 pounds. 100℔. at 1 cent per ℔.=100 cents=1 dollar.

Therefore, 100℔. of beef, at 4 cents a ℔. will come to 400 cents.=4 dollars.

What will 500℔. of pork come to at 8 cents a ℔.?

Your mind tells you 8 cents a ℔. is 8 dollars a 100℔., and 8 multiplied by 5 is 40; of course the answer is $40.

DIVISION OF FEDERAL MONEY.

Rule.—Write the number and divide as in simple division. The quotient will be of the same denomination as the lowest of the dividend. · Or, when you have divided the dollars of the dividend, put the comma or point in the quotient; if the dollars be less than the divisor, put the point down at first.

EXAMPLES.

1.	2.	3.
$ c. m.	$ c.	$ c m.
6)47,26 2	8)6914,24	11)7,49 1
7,87 7		

4.

$ c. m. $ c. m.

237)6742,27 1(28418+mills, or 28,41 8 and 95 Rem.

5.	6.	7.
$ c. m.	$ c. m.	$ c. m.
387)753,35 7(	359)259,23 7(	475)74,10 0(

APPLICATION.

1. If 131 yards of Irish linen cost $49,78c. what is it per yard? *Ans.* 38cts.

2. If 140 reams of paper cost $329, what is that per ream? *Ans.*.$2,35c.

3. If a reckoning of $25,41c. be paid in equal shares by 14 persons, what do they pay apiece? *Ans.* $1,81½c.

4. If a man's wages be $235,80c. a year, what is that a calendar month? *Ans.* $19,65c.

5. The salary of the President of the United States, is twenty-five thousand dollars a year; what is that a day?
Ans. $68,49c.+

6. If the amount of the Public Debt of the United States, be $91,680,090; how much would that be for each person to pay, allowing the number of inhabitants in the United States to be eleven millions? *Ans.* $8,33c. 4m.+

7. Divide $57 into 120 equal shares. *Ans.* 47½cents.

A SHORT RULE.

When the value of 100℔ of any article is given, to find, *mentally*, what it is per ℔.

Rule.—Call the dollars in the price of 100℔. cents, and *that* is the answer. If the value of several 100℔. is given, first divide, in your mind, the dollars in the price of the hundreds, by the number of hundreds, and the quotient will be the price of *one* hundred, in dollars, which call cents, as before directed, and *that* will be the answer. When the price of the 100℔. in either case, contains parts of a dollar, the parts of a dollar become parts of a cent in the price of the ℔.

100℔ valued at $5=100℔ valued at 500 cents; and 500 cents÷100=5 cents. Therefore if 100℔. of beef cost 6 dollars, or 600 cents, it cost 6 cts. a ℔.

What will a ℔ of pork be worth, when 800℔ are worth $48?

Your mind tells you 800℔ for $48 will be 100℔ for $6, or $48 divided by 8, the number of hundreds, will give $6 for the quotient, or price of 1 hundred; of course the price of a pound, or the answer, is 6 cents.

REDUCTION OF FEDERAL MONEY.

To reduce Dollars to Cents and Mills.

Multiply the dollars by 100 for cents, and the cents by 10 for mills or to the dollars annex two ciphers for cents and three for mills.

To reduce Mills and Cents to Dollars.

Divide the mills by 10, and the quotient will be cents; divide the cents by 100, and the quotient will be dollars;

or if the number be cents, point off two; and if mills, three figures on the right hand; then the figures on the left hand of the comma will be dollars, the two first on the right hand will be cents, and the third, if any, will be mills.

EXAMPLES.

1. Reduce 674 dollars to cents and mills.

```
  674
  100
 -----
 67400 Cents
    10
 ------
674000 Mills.
 ------
Or 67400 Cents.  } Ans.
  674000 Mills   }
```

2. How many dollars in 642179 mills?

```
 10)642179
   -------
100)64217-9
   --------
  $642-17-9    Or $642 17c. 9m. Ans.
```

3. How many mills in 47692 dollars? *Ans.* 47692000.
4. In 46791 cents, how many dollars? *Ans.* $467,91c.
5. In 6421796 mills, how many dollars, cents and mills? *Ans.* $6421 79c. 6m.

To reduce New-England currency to Federal Money.

Case I.—If the sum consist of pounds only, annex three ciphers to it and divide by 3; the quotient will be the answer in cents.*

EXAMPLES.

1. Reduce £3762 to Federal Money.

```
3)3762000
  -------
  1254000 Cents, or $12540 Ans.
```

2. Reduce £471 to Federal Money. *Ans.* $1570.
3. Reduce £37 to dollars and cents. *Ans.* $123 $33\frac{1}{3}$c.

* As a dollar is $\frac{6}{20}$ or $\frac{3}{10}$ of a pound, it is plain that annexing a cipher to the pounds, and dividing by 3, will give a quotient in dollars; and annexing other ciphers, and dividing by 3 will give tenths, hundredths, &c. of a dollar; or dimes, cents, &c.

CASE II.—If pounds and shillings are given, to the pounds annex half the number of shillings, and two ciphers, if the number of shillings be even; but if the number be odd, annex half the even number, and then 5 for the odd shilling, and one cipher, and divide by 3; the quotient is the answer in cents.

EXAMPLES.

1. Reduce £64 16*s*. to dollars and cents.

   3)64800

   Ans. 21600*cts.* or $216.
2. How many dollars in £41 14*s*.? *Ans.* $139.
3. In £26 1*s*. how many dollars and cents? *Ans.* $86,83⅓*cts.*
4. How many dollars in £1 17*s*.? *Ans.* $6,16⅔*cts.*

CASE III.—If there are shillings, pence, &c. in the given sum, annex for the shillings as before, and to these add the farthings contained in the pence and farthings; observing to increase their number by 1 when they exceed 12, and by 2 when they exceed 36; and divide as before.

EXAMPLES.

1. Reduce £34 16*s*. 4½*d*. to Federal Money.

   3)34819

   Ans. 11606⅓*cts.* or $116,06⅓*cts.*
2. In £2001 1*s*. 3½*d*. how many dollars? *Ans.* $6670,21⅔*cts.*
3. In £591 11*s*. 9½*d*. how many dollars? *Ans.* $1971,96⅔*cts*

To reduce FEDERAL MONEY *to New-England currency.*

CASE I.—When the sum is dollars only, multiply by 3: and double the product of the first figure for shillings, and the rest of the product will be pounds.

EXAMPLES.

1. Reduce 473 dollars to New-England currency.

   473
   3

   Ans. £141 18*s*.

2. How many pounds, &c. in 579 dollars?

Ans. £173 14*s*.

CASE. II.—When there are cents in the given sum, multiply the whole by 3, and cut off three figures of the product to the right hand as a remainder; multiply the remainder by 20, and cut off as before: proceed in the same manner through the several parts of a pound, and the numbers standing on the left hand make the answer in the several denominations.

NOTE.—If there be mills, cut off four figures, and proceed as before.

EXAMPLES.

1. Reduce $376,27*cts*. to New-England currency.

```
      376,27
           3
   ---------
   £112,881
          20
   ---------
  s. 17,620
          12
   ---------
   d. 7,440
           4
   ---------
  qr. 1,760
   ---------
```

Ans. £112 17*s*. 7¼*d*.+

2. Reduce $609,88⅓*cts*. to New-England currency.

Ans. £182 19*s*. 3½*d*.+

3. How many pounds, shillings, &c. in $429,21*cts*. 5 *mills*?

```
   429,215
         3
  --------
£128,7645, &c.
```

Ans. £128 15*s*. 3¼*d*.+

PRACTICAL QUESTIONS IN FEDERAL MONEY.

1. Having borrowed one hundred dollars, and paid at one time seventy dollars, and at another time sixteen dollars, seven cents; what is still due? Ans. $13,93*cts.*

2. What will 25 bushels of corn come to, at 92 cents per bushel? *A*ns. $23.

3. What will 376 pounds of butter come to, at 18 cents per pound? *A*ns. $67,68*cts.*

4. What will 39 bushels of wheat come to, at 1 dollar 75 cents per bushel? *A*ns. $68,25*cts.*

5. If Iron cost 6 dollars 50 cents per cwt., what is it per pound, 25℔ to the qr.? *A*ns. 6½*cts.*

6. If 240 pounds of pork come to 28 dollars 80 cents, what is it per pound? *A*ns. 12*cts.*

7. Borrowed 607 dollars 20 cents; paid £127, 16*s*. 9*d*.; what is the balance? *A*ns. $181,7½*cts.*

8. Lent 400 dollars; received 150 bushels of wheat at 10s. per bushel, and 200 pounds of butter at 17½ cents per pound, in payment: how much is still due?

*A*ns. $115.

9. What will 55 yards of linen come to, in Federal Money, at 3*s*. 9*d*. per yard, New-England currency?

*A*ns. $34,37*cts.* 5 *mills.*

10. What will 36 yards of broadcloth come to, in New-England currency, at 6 dollars 25 cents per yard?

*A*ns. £67 10*s*.

11. What will 7 tons of hay come to, at 16 dollars 75 cents per ton? *A*ns. $117 25*cts.*

12. What is the price of one cwt. of hay at 16 dollars 75 cents per ton? *A*ns. 83*cts.* 7½*mills.*

COMPOUND ADDITION.

Compound Addition in Arithmetic, teaches to collect several numbers of different denominations into one sum; as, pounds, shillings and pence, &c.; tons, hundreds, and quarters, &c.

Rule.—Place the numbers, so that those of the same denomination may stand directly under each other, ac-

cording to what you were told in Simple Addition. Add the first column or lowest denomination together, as in Simple Addition, also. Find how many units of the next higher denomination are contained in the sum, by dividing it by so many of this name, as make one in the next greater. Set down the remainder or overplus under the column added, and carry the ones or units (the quotient) to the next denomination, whose sum you must find, and proceed with as before; and so on through all the denominations to the highest, which add as in Simple Addition, setting down its whole sum.*

EXAMPLES.

MONEY.

	£.	s.	d.	£.	s.	d.	qr.	£.	s.	d.
	4210	16	11¼	97	12	6	2	63	9	4½
	1729	17	9	19	14	5	3	81	12	7
	53	11	3¼	46	17	9	1	27	16	10½
	207	18	6¾	22	19	10	2	16	14	6¼
	14	6	0¼	57	1	2	0	41	9	5
Sum.	6219	10	6¾							
	2008	13	7½							
Proof.	6219	10	6¾							

APPLICATION.

1. Bought a quantity of goods for £125 10*s.*; paid for truckage forty-five shillings, for freight seventy-nine shillings and sixpence, for duties thirty-five shillings and ten pence; and my expenses were fifty-three shillings and nine pence; what did the goods stand me in? Ans. £136 4*s.* 1*d.*

* The reason of this rule is evident; for in addition of money, as 1 in the pence, is equal to 4 in the farthings—1 in the shillings, to 12 in the pence—and 1 in the pounds, to 20 in the shillings, to carry as directed is, therefore, only to arrange properly the money, arising from each column, in the scale of denominations: and this reasoning will hold just in the addition of compound numbers of any kind whatever.

2. A prize being sold, and the sum divided equally among the captors, who were 6 in number, each man received two hundred and forty pounds, thirteen shillings and seven pence; what did the prize cost the purchaser?

Ans. £1444 1*s*. 6*d*.

TROY WEIGHT.

℔.	*oz.*	*dwt.*	*gr.*
671	10	16	13
392	8	9	21
249	7	12	12
516	4	3	7
627	5	17	16

℔.	*oz.*	*dwt.*	*gr.*
47	6	11	17
56	11	15	19
63	9	8	22
26	5	19	16
31	6	12	14

APPLICATION.

A gentleman bought of a silversmith, dishes to the weight of 23℔. 6oz. 5dwt.; plates 41℔. 7oz. 17dwt.; spoons 12℔. 15dwt.; salts 2℔. 7oz.; waiters 13lb.; and tankards 7lb. 17dwt.;—what weight of plate did he buy in all?

Ans. 99lb. 10oz. 14dwt.

AVOIRDUPOIS WEIGHT.

Ton.	*cwt.*	*qr.*	*lb.*	*oz.*	*dr.*
371	12	1	20	10	13
123	14	2	15	6	7
407	9	3	12	11	9
513	13	0	26	6	15
624	15	1	17	6	11

Ton.	*cwt.*	*qr.*	*lb.*
49	19	3	24
89	10	2	13
16	8	1	17
27	14	0	22
50	3	2	15

Here 25lb. a qr.

APPLICATION.

1. A merchant buys four bags of hops, of which No. 1, weighs 2cwt. 2qr. 10lb. No. 2, 2cwt. 1qr. 16lb. No. 3, 2cwt. 24lb. No. 4, 1qr. 16lb. He buys also a couple of pockets of hops, which weigh 58½lb. each. How many hundred weight has he to pay carriage for, on bringing them to town?

Ans. 8cwt. 2qr. 15lb.

2. A country shopkeeper buys of a merchant in Hallowell teas weighing 3qrs. 14lb.; coffee, 1qr. 23lb.; sugars,

3cwt. 2qr. 5℔.; spices 2qr. 3℔. 13oz.; hops 13cwt. 1qr. 24℔.; and several other things to the weight of 3cwt. 17℔. 7oz.; for what weight has he to pay carriage on bringing them home, 25℔. a qr.? Ans. 22cwt. 12℔. 4oz.

APOTHECARIES' WEIGHT.

℔.	℥.	ʒ.	℈.	*gr.*
26	10	7	2	13
54	7	2	1	12
76	8	3	0	14
83	9	4	2	6
41	6	0	1	19

℔.	℥.	ʒ.	℈.	*gr.*
17	9	4	1	14
55	10	6	2	10
61	4	2	1	9
92	11	5	0	18
21	6	3	1	17

APPLICATION.

An apothecary made a composition of 5 ingredients, the 1st of which weighed 13℔. 7oz.; the 2d, 11oz. 7dr. 13gr.; the 3d, 7℔. 2scr.; the 4th, 11℔. 3dr. 1scr.; and the 5th weighed 15℔. 5oz. 7gr.;—what was the weight of the whole? Ans. 48℔. 3dr. 1scr.

CLOTH MEASURE.

Yd.	*qr.*	*na.*	*E. E.*	*qr.*	*na.*	*E. Fr.*	*qr.*	*na.*	*E. Fl.*	*qr.*	*na.*
46	1	2	74	2	3	86	5	2	29	1	2
12	3	3	51	4	1	61	4	1	17	2	3
62	1	1	24	1	2	52	3	9	20	1	2
83	2	5	56	3	1	24	2	1	75	0	1
41	0	1	31	1	2	10	0	3	46	1	2

APPLICATION.

1. Having bought four parcels of cloth, the first of which contains 25yds. 3qrs.; the 2d, 37yds. 2qrs. 3na.; the 3d, 14yds. 1na.; and the 4th, 23yds.; I desire to be informed by you how many yards are in them all?

Ans. 100yds. 2qrs.

2. I have six parcels of cloth; the first contains 3 E. Fl. and 3na.; the 2d, 14yds. 1qr.; the 3d, 15E. E. 2qr. 2na.; the 4th, 1qr. 3na.; the 5th, 19E. Fr.; and the 6th, 255yds.;—how many yards are there in all?

Ans. 320 yds.

LONG MEASURE.

Deg.	mi.	fur.	pol.	ft.	in.	bar.
21	17	2	26	12	10	2
46	58	6	19	14	6	1
18	62	4	31	10	7	0
21	19	7	14	8	3	2
62	37	1	29	7	6	1

Mi.	fur.	rod.	yd.	ft.
62	1	36	4½	2
75	3	24	3	1
49	5	12	2½	2
14	4	17	0	0
25	2	10	3	2

APPLICATION.

1. From A to B is 3mi. 2fur. 7pol.; from B to C is 17 mi. 13pol.; from C to D is 7fur.; and from D to E 5 mi. 38pol.; what is the distance from A to E?

Ans. 26mi. 2fur. 13pol.

2. A person rode four days; on the 1st day he went 39 mi. 6fur.; the 2d day, 46mi. 24pol.; the 3d, 60mi. 4fur. 39pol.; and the 4th day he went but 37mi. 6fur.; what was the whole distance of his journey?

Ans. 184mi. 1fur. 23pol.

LAND OR SQUARE MEASURE.

Acre.	rood.	rod.	yd.	ft.	in.
271	1	27	16	4	110
424	2	31	21¼	2	96
512	3	16	10	7	71
328	2	21	9	1	120
246	1	12	21¼	6	74

Acre.	rood.	rod.
21	2	37
52	1	24
28	2	16
43	3	31
65	0	20

APPLICATION.

1. There are 5 lots of land, the 1st of which measures 13ac. 3roo. 14rods; the 2d, 27ac. 29rods; the 3d, 19ac. 1roo.; the 4th, 3roo. 34rods; and the 5th, 45ac. 2roods, 11rods; what ground do they all contain.

Ans. 106ac. 3roods, 8rods.

2. A gentleman dividing his estate among 4 sons, gave the 1st, 150acres, 1rood, 39rods; the 2d, 100acres, 25rods; the 3d, 75acres; and the 4th, 55acres, 1rood, 16rods;—how large was the whole farm? Ans. 381acres.

CUBIC OR SOLID MEASURE.

Tons round.	*feet.*	*inches.*	*Tons hewn.*	*feet.*	*Cords.*	*feet.*
21	36	476	67	30	36	102
62	17	965	24	27	61	90
47	19	816	62	14	52	76
31	28	1146	39	36	9	120
19	34	1452	17	20	12	34

APPLICATION.

1. Required, the solid contents of four pieces of round timber, the first of which measured 2 tons, 39 feet, 94 inches; the 2d, 4 tons, 1695 inches; the 3d, 35 feet, 1183 inches; and the 4th, 1 ton, 25 feet.

Ans. 9T. 20ft. 1244in.

2. Bought of A, 14 cords, 1727 solid inches of wood; of B, 19 cords, 127 solid feet; of C, 7 cords, 98 feet, 1101 inches; of D, 9 cords; and of E, 63 feet, 1210 inches; how much did I buy in all?

Ans. 51c. 34ft. 582in. or 51c. 2¼ft. + Wood Measure.

DRY MEASURE.

Chal.	*bus.*	*pk.*	*qt.*	*pt.*
39	4	1	6	1
57	6	3	4	0
61	7	2	3	1
52	4	2	5	1
42	1	1	2	1

Bus.	*pk.*	*gal.*	*qt.*	*pt.*
62	2	1	3	1
79	3	0	2	1
42	2	1	1	1
17	1	1	2	0
86	0	1	0	1

APPLICATION.

1. A corn-merchant sends over the sea, of wheat 130 bushels, 3 pecks, 1 gallon, 1 pint; of oats 290 bushels, 1 gallon, 3 quarts; of rye he has sent 300 bushels, 3 quarts; of pease 80 bushels, 3 pecks; and of beans 50 bushels; for what number of bushels does he pay freight?

Ans. 851bus. 3pks. 1 gal. 2qts. 1pt.

2. How many chaldrons of coals are there in four loads, the 1st containing 14 chaldrons, 27 bushels, 2 pecks, 1 quart; the 2d, 9 chaldrons, 3 pecks; the 3d, 29 chaldrons, 3 quarts; and the 4th, 35 chaldrons, 7 bushels, 2 pecks, 4 quarts? Ans. 88 chaldrons.

WINE MEASURE.

Tun.	hhd.	gal.	qt.	pt.	gill.
2	1	42	1	0	3
5	3	51	2	1	1
7	2	60	1	1	2
9	1	26	1	0	3
6	1	17	3	1	1

Hhd.	gal.	qt.
68	31	3
47	59	1
29	48	1
63	37	0
47	18	1

APPLICATION.

1. A gentleman bought of a wine-merchant, of port wine, 1tun, 3hhds.; of claret, 3hhds. 47gal.; of mountain, 1hhd. 5gal.; and of Lisbon, 2hhds. 23gal.; what quantity did he buy in all? Ans. 2tuns, 2hhds. 12gal.

2. Imported from Cadiz, Lisbon, Oporto, and Madeira, 4 lots of wine, the 1st of which contained 3tuns, 3hhds. 61gal. 2qt. 1pt.; the 2d, 2pipes, 1hhd 48gal. 3gills; the 3d, 2hhds. 41gal. 1 gill; and the 4th, 6pipes, 3hhds. 38gal. 1qt.; how much did I have in all? Ans. 10 tuns.

ALE OR BEER MEASURE.

Hhd.	gal.	qt.
416	29	3
34	17	2
173	15	1
315	47	1
351	34	1

A.fir.	gal.	qt.
69	7	2
43	5	1
53	4	1
46	3	3
29	1	1

Butt.	bbl.	gal.	qt.
25	1	24	1
36	2	30	2
81	0	16	0
24	1	25	1
98	1	18	1

APPLICATION.

1. A beer-brewer has sent into the country, ale, as follows, viz. at one time 3hhds. 14gal. 3qt.; at another, 2 hhds. 16gal.; at another, 14hhds. 27gal. 2qt; and at another, 6hhds. 3qt.; how much was sent in all?

Ans. 26hhds. 5gal.

2. Bought 4 lots of beer; the 1st contained 3butts, 1 bbl. 3qt.; the 2d, 1butt, 34gal. 1qt.; the 3d, 2bbls. 2qt.; and the 4th, 5butts, 1bbl. 2qt.; what did I buy in all?

Ans. 10butts, 2bbls.

TIME.

Yr.	m.	w.	d.	h.	m.	s.
37	10	2	6	17	31	32
46	9	3	2	14	47	25
58	7	1	4	13	19	31
61	5	0	5	12	50	47
94	12	3	1	21	39	56

Yr.	days.	h.	m.
41	276	20	30
81	310	17	48
47	163	8	29
21	360	19	50
72	176	14	33

APPLICATION.

1. Peter's father was 28 years old (reckoning 13 months to a year, and 28 days to a month,) when Peter was born; betwixt Peter and John were 2yrs. 10m. 16d.; between John and James, 1yr. 11m.; and between James and Job, 3yrs. 7m. 25d.; when Job is 16yrs. 9m. 27d. old, how old is their father? Ans. 53yrs. 12 days.

2. Four memorable events occurred, between the 1st and 2d of which were 21yrs. 236d. 7h. 40m. 50s.; betwixt the 2d and 3d, 48yrs. 19h. 53s.; and between the 3d and last, 30yrs. 128d. 3h. 18m. 17s.; now, allowing 365d. and 6 hours to the year, I wish to know what period of time elapsed between the first and last of those events?

Ans. 100 years.

CIRCULAR MOTION.

S.	°	′	″
2	15	42	57
5	19	55	33
1	22	47	28
3	10	20	12
1	9	11	21

°	′	″
41	54	39
64	27	21
52	36	42
78	10	16
93	25	34

APPLICATION,

1. If the sun's motion in the zodiac be, one day, 1° 1′ 10″; on another, the same; on the next, 1° 1′ 11″; on the next, 1° 1′ 10″; and on the next two, 1° 1′ 11″ each day; what distance does he move in the six days?

Ans. 6° 7′ 3″.

2. If the moon's motion in the signs be, on one day, 13° 28′ 4″; on another, 13° 2′ 23″; on another, 12° 40′ 1″; on another, 12° 21′ 47″; on another, 12° 7′ 50″; and on another, 11° 58′ 7″; what distance does she move in the six days? Ans. 2S. 15° 38′ 12″.

COMPOUND SUBTRACTION.

Compound Subtraction is finding the difference between two numbers, of which one or both are compound.

Rule.—Set the less number under the greater, as directed in Compound Addition. Then, beginning at the least denomination, subtract the under number of each from the upper, writing their respective remainders below them. But if the under number of any of the denominations be greater than the upper, add so many to the upper as make one of the next higher denomination; then take the under number from that sum, writing down the remainder as before, and carry or add one to the under number of the next higher denomination before you subtract it.—The method of proof is the same as in Simple Subtraction.

EXAMPLES.

MONEY.

	£.	s.	d.		£.	s.	d.	qr.		£.	s.	d.
From	691	12	6½		34	11	4	1		81	17	6¼
Take	284	15	9¾		17	14	10	3		21	12	4½
Rem.	406	16	8¾									
Proof	691	12	6½									

APPLICATION.

1. What sum added to £17 11s. 8¼d. will make £100?

Ans. £82 8s. 3d. 3qrs.

2. Borrowed £50 10s.; paid again, at one time £17 11s. 4d.; at another, £9 4s. 8d.; at another, £7 9s. 6d.; and at another, 19s. 6½d.; how much remains unpaid?

Ans. £15 4s. 11½d.

TROY WEIGHT.

lb.	oz.	dwt.	gr.		lb.	oz.	dwt.	gr.
39	8	14	16		71	9	16	11
16	10	10	18		85	1	17	20

APPLICATION.

Sent to a Silversmith 9*lb.* 8*oz.* 14*gr.* of silver to be wrought; he makes me four dozen of spoons, weighing 8*lb.* 8*oz.* 6*dwt.* 21*gr.*; how much silver is left?

Ans. 11oz. 13dwt. 17gr.

AVOIRDUPOIS WEIGHT.

Ton.	*cwt.*	*qr.*	*℔.*
73	11	1	21
39	17	2	12

Cwt.	*qr.*	*℔.*	*oz.*	*dr.*
94	2	11	8	9
47	3	17	11	10

Here 25lb. a qr.

APPLICATION.

1. Bought 17cwt. 2qr. 14lb. of sugar, of which I sold 9cwt. 3qr. 25lb.; how much remains unsold?

Ans. 7cwt. 2qrs. 17lb.

2. Bought, at one time, 9cwt. 3qrs. 21lb. 8oz. of iron, and sold, next day, 8cwt. 1qr. 24lb. 14oz.; bought at another time, 15cwt. 13lb. 15oz. of the same kind, and sold the same week, 15cwt. 1qr.; what remains unsold of the two parcels, 25lb. a qr.? Ans. 1cwt. 1qr. 10lb. 9oz.

APOTHECARIES' WEIGHT.

℔.	℥.	ʒ.	℈.	*gr.*
81	7	2	0	11
47	2	4	2	15

℔.	℥.	ʒ.	℈.	*gr.*
69	10	4	1	12
30	11	1	2	17

APPLICATION.

Bought of an apothecary sundry articles, weighing 13℔. 5℥. 2℈.; he compounded two parcels from them, one of which weighed 7℔. 7ʒ. 19gr., and the other, 4℔. 4℥. 1℈. 1gr.; how much was left uncompounded?

Ans. 2℔. 1ʒ.

CLOTH MEASURE.

Yd.	*qr.*	*na.*
42	1	2
17	2	1

E. Fl.	*qr.*	*na.*
74	1	3
40	2	1

E. E.	*qr.*	*na.*
21	3	1
9	4	2

E. Fr.	*qr.*	*na.*
39	4	2
12	0	3

APPLICATION.

1. From a fashionable piece of cloth, which contained 52yds. 2na., a tailor was ordered to take 3 suits, each 6yds. 2qrs.; how much remains of the piece?

Ans. 32yds. 2qrs. 2na.

2. Swapped with John Jones a piece of Irish linen containing 36yds. 1qr. 3na. for a piece of Holland containing 20E.Fl. 2qrs. 1na.; and swapped also with Seth Sears a piece of sheeting measuring 41E.E. 4qrs. 2na. for a piece of French cambric measuring 30E.Fr. 5qr. 3na.; each agreed to pay me the balance, in quantity, in jean; how many yards of jean must I receive from both?

Ans. 26yds. 3qrs. 1na.

LONG MEASURE.

Deg.	*mi.*	*fur.*	*pol.*	*ft.*	*in.*	*bar.*
81	30	4	24	12	1	1
29	41	5	13	14	1	2

Mi.	*fur.*	*pol.*	*yd.*	*ft.*
74	3	16	4	1
48	5	37	2	2

APPLICATION.

1. Paul travelled three days, going 33mi. 5fur. 37pol. 2yd. 2ft. each day; Amos set out with him, but travelled only 28mi. 7fur. 1yd. 2ft. each day; at the end of the third day, how far was Amos behind Paul?

Ans. 14mi. 4fur. 31pol. 3yd.

2. The ship Sea-horse, bound to a port at 320 leagues' distance, sailed 6 days at an average rate of 120mi. 18pol. 9in. every 24 hours; at the end of the six days, how far short of her destined port was she?

Ans. 79leag. 2mi. 5fur. 11pol. 12ft.

LAND OR SQUARE MEASURE.

Acre.	*roo.*	*per.*	*yd.*	*ft.*	*in.*
93	2	27	14	7	101
64	3	14	16¼	8	92

Ac.	*roo.*	*per.*
39	2	17
16	3	19

APPLICATION.

1. Rufus, David, Moses, and Robert owned, together, 542ac. 1roo. 34rods, 29¼yds. 7ft. 142in. of land; the first had 101acr. 3roo. 21rod. 4ft. 139in.; the 2d, 99acr. 4¾yds.; the 3d, 97acr. 24per. 8ft. 99in.: how much, then, had the fourth?

Ans. 244ac. 1roo. 29 per. 23½ yds. 3ft. 48in.

2. A man had 1000 acres of land, which he divided among his three sons; giving Abraham 156ac. 3roo. 14 rod. 27yds. 8ft. 125in.; Isaac as much again; and Jacob the rest; pray how much had Jacob?

Ans. 529ac. 1roo. 33per. 6¾yd. 57in.

CUBIC OR SOLID MEASURE.

T. rou.	*ft.*	*inches.*	*T. hewn.*	*ft.*	*Cord.*	*ft.*
64	37	1141	802	26	31	39
17	19	1400	204	31	5	107

APPLICATION.

1. Agreed with Noah Nott for 134tons, 20ft. of round timber; he has drawn 99tons, 39ft. 1701in.; how much more must he haul to complete the contract?

Ans. 34tons, 20ft. 27in.

2. I bought 94tons, 25ft. 1600in. of hewn timber, of which I have sold F. Francis 54tons. 45ft. 1709in.; and Saul Swift agrees to take the rest; how much less will be the quantity taken by Swift than that taken by Francis?

Ans. 15tons, 16ft. 90in.

DRY MEASURE.

Chal.	*bus.*	*pk.*
103	17	1
94	31	2

Bus.	*pk.*	*gal.*	*qt.*	*pt.*
62	1	0	2	1
15	2	0	3	2

APPLICATION.

1. A merchant contracted for 6000 bushels of wheat, which was shipped on board of two vessels; one arrived, and brought 3000bus. 2pk. 1gal. 3qt. 1pt.; the other never came into port; how much less was lost than was saved?

Ans. 1bus. 1pk. 1gal. 3qts.

2. Having 199 chaldrons of coals, I sell George Green 99chal. 34bus. 1pk., and Mark Mann the rest; how much less has Mark than George?

Ans. 32bus. 2pk.

[illegible] MEASURE.

[illegible]				Hhd.	gal.	qt. pt.	gill.
[illegible]				61	31	2 1	1
[illegible]				17	51	3 0	1

[illegible]

[illegible] of wine; it was [illegible] 30pipes, [illegible] how much [illegible]?

[illegible] and 1qt.

[illegible] 1pt. 1gill [illegible] pipes, 3qts. [illegible] how much less [illegible]?

[illegible] 1gill.

[illegible]

[illegible]		[illegible]	h.	m.
[illegible]		[illegible]	11	47
[illegible]		[illegible]	4	6

[illegible]

[illegible] which gave [illegible] 19, 1775, [illegible]; how [illegible]?

[illegible] 1day.

[illegible] and it be [illegible] be [illegible]

[illegible] 19days.

[illegible] his two [illegible] 11years, 11 [illegible] minutes, [illegible] 4 weeks a [illegible]

[illegible] 12h. 49m.

COMPOUND MULTIPLICATION.

Compound Multiplication teaches to find the amount of any given number of different denominations by repeating it any proposed number of times.

Rule.—Place the multiplier under the lowest denomination of the multiplicand. Multiply the number of the lowest denomination by the multiplier, and find how many units of the next higher denomination are contained in the product, as in Compound Addition; write down the excess, and carry the quotient, or ones, to the product of the next higher denomination, with which proceed as before, through all the donominations to the highest; whose product, with the several excesses, will be the whole amount required.—The method of proof is the same as in Simple Multiplication.

CASE I.—Examples.

MONEY.

	£.	s.	d.		£.	s.	d.	qr.		£.	s.	d.
Multiply	37	17	$6\frac{3}{4}$		21	12	9	2		11	9	$4\frac{1}{2}$
by			5					4				6
Prod.	£188	2	$9\frac{3}{4}$									

APPLICATION.

1. What will 7 barrels of flour come to, at £2 16*s.* 6*d.* per barrel? Ans. £19 15*s.* 6*d.*

2. What will 6 pounds of tea come to, at 5s. 3d.? Ans. £1 11s. 6d.

3. - - - 8 pounds coffee, at 2s. $1\frac{1}{2}$d.? Ans. 17s.

4. - 11 gallons rum, at 5s. $9\frac{3}{4}$d.? Ans. £3 3s. $11\frac{1}{4}$d.

TROY WEIGHT.

lb.	oz.	dwt.	gr.		lb.	oz.	dwt.	gr.
3	0	14	9		71	9	16	11
			3					4

APPLICATION.

What is the weight of six silver porringers, each weighing 11*oz.* 18*dwt.*? Ans. 5lb. 11*oz.* 8*dwt.*

AVOIRDUPOIS WEIGHT.

Ton.	cwt.	qr.	℔.		℔.	oz.	dr.
1	17	3	23		21	11	15
			5				6

Here 25℔. a qr.

APPLICATION.

1. What is the weight of 6 barrels of sugar, each weighing 1cwt. 3qrs. 20℔.? Ans. 11cwt. 2qrs. 8℔.

2. What is the weight of 12 hogsheads of sugar, each 13cwt. 2qrs. 23℔., 25℔. a qr.? Ans. 164cwt. 3qrs. 1℔.

3. What is the weight of 6 chests of tea, each weighing 3cwt. 2qrs. 9℔., 25℔. a qr.? Ans. 21cwt. 2qr. 4℔.

CLOTH MEASURE.

Yds.	qr.	na.		E.Fl.	qr.	na.		E.E.	qr.	na.
3	1	3		91	2	1		61	4	3
		7				8				9

APPLICATION.

1. What number of yards is in 8 pieces of broadcloth, each 32yds. 3qrs. 1na.? *A*ns. 260yds. 2qrs.

2. If 8 E. E. 3qrs. 3na. of broadcloth will make a suit of clothes; how much of the same cloth will make 12 similar suits? *A*ns. 105 E. Eng.

LONG MEASURE.

Deg.	mi.	fur.	pol.	ft.	in.	bar.		Mi.	fur.	pol.	yds.	ft.
5	31	3	27	14	8	2		7	5	21	5	1
						10						11

APPLICATION.

1. How far will a man travel in 7 days, if he go 31mi. 31pol. 6ft. 6in. every day?

*A*ns. 217m. 5fur. 19pol. 12ft. 6in.

2. If, in a race, a horse move 14ft. 7in. 2bar. at every bound, and take 2 bounds in every second, what course will he run over in 12 seconds? *Ans.* 117yds. 4in.

LAND OR SQUARE MEASURE.

Ac.	*roo.*	*per.*	*yd.*	*ft.*	*in.*		*Ac.*	*roo.*	*per.*
15	3	19	13	7	72		39	1	37
					8				9

APPLICATION.

1. In 9 fields each containing 14 acres, 1 rood, and 25 perches, how many acres? Ans. 129ac. 2roo. 25per.

2. If a man divide his farm among his seven sons, and give each 51ac. 31per. 8ft., how much does the farm contain? Ans. 358ac. 1roo. 17per. 6yd. 2ft.

CUBIC OR SOLID MEASURE.

T. rou.	*ft.*	*in.*		*T. hewn.*	*ft.*		*Cord.*	*ft.*
1	39	845		24	49		12	124
		5			8			9

APPLICATION.

1. Bought 5 boat loads of round timber, each of which contained 3tons, 28ft. 1111in.; what is the whole quantity? Ans. 18tons, 23ft. 371in.

2. In six parcels of wood, each containing 5cords, 96ft. how many cords? Ans. 34½cords.

DRY MEASURE.

Chal.	*bus.*	*pk.*		*Bus.*	*pk.*	*gal.*	*qt.*	*pt.*
54	35	2		9	3	1	2	1
		6						7

APPLICATION.

1. There were six wagons loaded with coals, each of which contained 1chal. 8bus. 3pk.; what was the total quantity? Ans. 7chal. 16bus. 2pk.

2. Nine loads of wheat were bought by a miller, each of which contained 21bus. 1pk. 1gal. 1qt. 1pt.; what was the total quantity? Ans. 192bus. 3pk. 1qt. 1pt.

WINE MEASURE.

Tun.	*hhd.*	*gal.*	*qt.*
10	3	17	1
			11

Hhd.	*gal.*	*qt.*	*pt.*	*gill.*
1	49	2	1	1
				12

APPLICATION.

1. How much brandy in 9 casks, each containing 41 gal. 3qt. 1pt.? Ans. 376gals. 3qts. 1pt.

2. How much cider may be put into eight rum casks, each of which will hold 104gals. 2qt. 1pt. 3gills? Ans. 837$\frac{3}{4}$gals.

TIME.

Yr.	*m.*	*w.*	*d.*	*h.*	*m.*	*s.*
4	12	2	5	10	10	10
						12

Yr.	*days.*	*h.*	*m.*
1	224	5	40
			8

APPLICATION.

If a solar year contain just 365 days, 5 hours, 48 minutes, and 48 seconds, what time is equal to 7 solar years? Ans. 2556days, 16h. 41m. 36s.

CASE II.—If the multiplier exceed 12, multiply successively by its component parts, as in Case II in Simple Multiplication.

EXAMPLES.

1. What will 21yds. of calico come to, at 2s. 7$\frac{1}{2}$d. per yard?

$3\times7=21$

	2 7$\frac{1}{2}$
	7
	18 4$\frac{1}{2}$ price of 7 yards.
	3
Ans. £2	15 1$\frac{1}{2}$ price of 21 yards.

2. What will 18 yards come to, at £1 7s. 2$\frac{1}{2}$d. per yard? Ans. £24 9s. 9d.

3. What will 36 pair of shoes come to, at 13s. 4d. per pair? Ans. £24.

4. What will 49 yards of broadcloth cost, at 17*s*. 6¾*d*. per yard? Ans. £43 0s. 6¾d.

5. A gentleman is possessed of 1½doz. silver spoons, each weighing 2oz. 15dwt. 11gr.; 2doz. teaspoons, each 10dwt. 14gr.; and two silver tankards, each 21oz. 15dwt.; pray what is the weight of the whole?

Ans. 8lb. 10oz. 2dwt. 6gr.

6. What is the weight of 42 tubs of butter, each 16lb. 14oz. 12dr., 25lb. a qr.? Ans. 7cwt. 10lb. 11oz. 8dr.

7. How many yards in 81 pieces of cloth, each 7yds. 3qr. 1na.? Ans. 632yds. 3qrs. 1na.

8. How many bushels in 63 casks, each containing 4bus. 3pks. 1gal.? Ans. 307bus. 1gal.

CASE III.—If the multiplier be not a composite number, find the nearest to it, either greater or less; multiply by the component parts as before, and for the odd parts add or subtract as the case requires.

EXAMPLES.

1. What will 65¼ yards of cloth come to, at £1 14s. 6½d. per yard?

	£1	14	6½		
			8		
8×8=64	13	16	4	price of eight yards.	
64+1¼=65¼			8		
	110	10	8	price of 64 yards.	Add
4)	1	14	6½	price of 1 yard.	Add
		8	7½	price of ¼ yard.+	Add
Ans.	£112	13	10	price of 65¼ yards.	

2. What will 76 yards cost, at 14s. 9½d. per yard?

	£0	14	9½	
7×11=77—1=76			11	
	8	2	8½	price of 11 yards.
			7	
	56	18	11½	price of 77 yards.
Subtract		14	9½	price of 1 yard.
Ans.	£56	4	2	price of 76 yards.

3. What will 183 gallons of brandy cost, at 7s. 5d.?

$10\times10=100$

$10\times8=80$

$3=3$ Then $100+80+3=183$.

Ans. £67 17s. 3d.

4. What will 600 yards of cloth cost, at £1 2s. 7½d.?

$10\times10\times6=600$ Ans. £678 15s 0d.

5. If a man travel 46mi. 7fur. 30pol. 3yd. 2ft. every day, for 57½ days, how far will he go?

Ans. 2700mi. 6fur. 23pol. 1yd. 2ft. 6in.

6. If a farm consist of 43 lots, and each lot contain 3*ac.* 3*roo.* 3*per.* 3*yds.* 3*ft.* 3*in.*; how large is the farm?

Ans. 162*ac.* 13*per.* 22*yds.* 3*ft.* 129*in.*

7. In 51 loads of bark, each 1 cord, 26 feet, how many cords? Ans. 61cor. 46ft. or 61cor. 2⅞ft. bark meas.

8. If a cargo of wine consists of 122 casks, and each cask contains 51gal. 3qts. 1pt. how many tuns in all?

Ans. 25tuns, 28gal. 3qts.

9. If a person waste 1hour, 32min. 41sec. every day, for 38 years, how much time does he lose in the whole period, allowing 365¼ days to the year?

Ans. 2yrs. 162da. 19h. 58m. 19½s.

COMPOUND DIVISION.

Compound Division teaches to find how often one number is contained in another of different denominations.

Rule.—Place the numbers as in Simple Division. Begin at the left hand, and divide each denomination by the divisor, setting the quotients under their respective dividends; but if there be a remainder in dividing any of the denominations except the lowest, find how many of the next lower denomination it is equal to; and add it to the number, if any, which was in this denomination before; divide this sum as usual, and thus proceed until the whole is finished.

The method of proof is the same as in Simple Division.

CASE I.—*EXAMPLES.*

MONEY.

£.	s.	d.		£.	s.	d.	qr.		£.	s.	d.
8)39	11	$6\frac{1}{4}$		6)22	9	4	2		5)71	13	$8\frac{3}{4}$
4	18	$11\frac{1}{4}$+									

APPLICATION.

1. Divide £67 10s. 9d. by 7. Ans. £9 12s. $11\frac{1}{2}$d.+
2. Divide £8 equally among 6 persons.
Ans. £1 6s. 8d.

TROY WEIGHT.

lb.	oz.	dwt.		lb.	oz.	dwt.
4)13	1	15		6)1	0	0

APPLICATION.

If 2lb. 9oz. 5dwt. 12gr. of silver be wrought into a dozen spoons, what will each weigh?
Ans. 2oz. 15dwt. 11gr.

AVOIRDUPOIS WEIGHT.

Cwt.	qr.	lb.		Tons.	cwt.	qr.
8)75	1	12		8)3	0	0
Here 25lb. a qr.						

APPLICATION.

1. Divide 13cwt. 1qr. 12lb. 6oz. 10dr. by 11.
Ans. 1cwt. 24lb. $9\frac{7}{11}$dr.
2. Divide 17cwt. 1qr. of sugar equally among 6 persons, at 25lb. a qr. Ans. 2cwt. 3qrs. $12\frac{1}{2}$lb.

CLOTH MEASURE.

Yd.	qr.	na.		E.E.	qr.	na.
5)31	2	3		9)1	0	0

APPLICATION.

1. If 8 equal pieces of cloth contain 260yds. 2qrs. what does each piece contain? Ans. 32yds. 2qr. 1na.

2. If 105 E.Eng. will make 12 suits of clothes, what does it take for one suit? Ans. 8E.E. 3qr. 3na.

LONG MEASURE.

	Deg.	mi.	fur.	pol.	ft.	in.	bar.
10)	6	31	3	28	14	8	2

	Mi.	fur.	pol.	yd.	ft.
11)	7	5	21	5	1

APPLICATION.

1. If a man travel 217 miles, 5 furlongs, 19 poles, 12 feet, 6 inches, in 7 days; how far does he go a day? Ans. 31mi. 31pol. 6ft. 6in.

2. If, in a race, a horse go over a course of 117 yards, 4 inches, in 12 seconds, how far does he move in one second? Ans. 9yds. 2ft. 3in. 1bar.

LAND OR SQUARE MEASURE.

	Ac.	roo.	per.	yd.	ft.	in.
8)	15	3	20	8	7	72

	Ac.	roo.	per.
9)	39	1	37

APPLICATION.

1. If nine fields of equal extent, contain 129 acres, 2 roods, 25 perches, what does one of them measure? Ans. 14 acres, 1 rood, 25 perches.

2. If a man divide his farm of 358 acres, 1 rood, 17 perches, 6 yards, 2 feet, in equal portions, between seven sons, what does each have? Ans. 51ac. 31per. 8ft.

CUBIC OR SOLID MEASURE.

	T. rou.	ft.	in.
5)	1	39	845

	T. hewn,	ft.
8)	24	49

	Cords,	feet.
9)	12	124

APPLICATION.

1. Bought 18tons, 23ft. 371in. of round timber, which was in five boats, and each contained a like quantity; how much did one boat contain?

Ans. 3tons, 28ft. 1111in.

2. In six equal parcels of wood I have $34\frac{1}{2}$ cords; what is in each parcel? Ans. 5cords, 96ft.

DRY MEASURE.

Chal.	*bus.*	*pk.*
6)51	35	2

Bus.	*pk.*	*gal.*	*qt.*	*pt.*
7)9	3	1	2	1

APPLICATION.

1. If in nine equal loads of corn there be 192bus. 3pk. 1qt. 1pt., what is there in one load?

Ans. 21bus. 1pk. 1gal. 1qt. 1pt.

2. Six wagons equally loaded drew to market 7chal. 16bus. 2pk. of coals; how much did one bring?

Ans. 1chal. 8bus. 3pk.

WINE MEASURE.

Tuns.	*hhd.*	*gal.*	*qt.*
11)19	3	17	1

Hhd.	*gal.*	*qt.*	*pt.*	*gill.*
12)1	49	2	1	1

APPLICATION.

1. In nine equal casks, I have 376gal. 3qts. 1pt. of brandy; how much is in one cask?

Ans. 41gal. 3qts. 1pt.

2. I have put into 8 rum hogsheads $837\frac{3}{4}$gal. of cider, each being filled alike; how much is in each cask?

Ans. 104gal. 2qts. 1pt. 3gills.

TIME.

Yr	*m.*	*w.*	*d.*	*h.*	*m.*	*s.*
12)4	12	2	5	10	10	10

Yr.	*d.*	*h.*	*m.*
5)4	224	5	40

APPLICATION.

If in seven solar years, there be just 2556 days, 16h. 41m. 36s., what is the length of one solar year?

Ans. 365days, 5h. 48m. 48s.

CASE II.—If the divisor exceed 12, divide continually by its component parts, as in Simple Division, CASE III.

EXAMPLES.

1. Divide £37 16s. equally among 24 men.

	£	s.	d.
6)	37	16	0
4)	6	6	0
	£1	11	6 Ans.

2. If 20 gallons of brandy cost £7 5s. 10d., what is it per gallon? Ans. 7s. 3½d.

3. Bought 3dozen of silver spoons, which, together, weighed 9lb. 8oz. 12grains; how much silver did each spoon contain? Ans. 3oz. 4dwt. 11gr.

4. Divide a hhd. of sugar, weight 12cwt. 3qrs. 7lbs. equally among 16 men, 25lb. a qr. Ans. 3qrs. 5lb. 2oz.

5. Divide 43yds. 1qr. 1na. of crape among 33 persons. Ans. 1yd. 1qr. 1na.

6. If a person travel 17leagues, 1mi. 4fur. 21pol. in 21 hours, what was the average distance an hour? Ans. 2mi. 4fur. 1pol.

7. Divide 1000 acres of land equally among 99 persons. Ans. 10ac. 16$\frac{1}{3}\frac{6}{3}$per.

8. Divide 500 cords of bark, in equal parts, among 108 persons. Ans. 4cor. 80$\frac{64}{108}$ft. or 4cor. 5$\frac{1}{27}$ft. bark meas.

9. Divide 168bushels, 1pk. 1gal. 2qts. of corn, equally among 35 persons. Ans. 4bus. 3pk. 2qt.

10. Divide 4½ gallons of brandy equally among 144 soldiers. Ans. 1gill each.

CASE III.—If the divisor be not a composite number, divide as in long division.

EXAMPLES.

1. Divide £391 17s. 6¼d. equally among 46 men.

```
    £.     s.   d.  £.   s.  d.
46)391    17   6¼(8    10   4½ Ans.
   368
   ---
    23
    20
   ---
 46)477(10s.
    46
    --
     17
     12
    ---
 46)210(4d.
    184
    ---
     26
      4
    ---
 46)105(2qrs.
     92
    ---
     13
```

2. If 263 bushels of wheat cost £86 11s. 5d. what is it per bushel?

```
      £.   s.   d.
263)86   11   5(£0 6s. 7d. Ans.
    20
    --
263)1731(6s. &c.
```

3. Divide 27tons, 13cwt. 2qrs. of iron equally among 34 men, 25lb. a qr.

```
   T.  cwt.  qr.  T. cwt. qr.  lb.
34)27   13    2(0   16    1    2 and 32 rem. or 32/34.
   20
   --
34)553(16cwt. &c.   Ans. 16cwt. 1qr. 2lb.
```

4. If 46lb. of indigo cost £53 10s. 6d., what is it per pound? *Ans.* 1lb. 3s. 3¼d. +

5. If 263 bushels of wheat cost $287,97cts. 3mills, what is it per bushel? Ans. $1,9cts. 4mills.+

6. If 37 thousand of boards come to $203,50cts., what is one thousand worth? Ans. $5,50cts.

7. Divide 120 months, 2w. 3d. 5h. 20m. by 111.
Ans. 1mo. 2d. 10h. $12\frac{68}{111}$m.

8. A privateer takes a prize worth $12465, of which the owner takes one-half, the officers one-fourth, and the remainder is equally divided among the sailors, who are 125 in number; how much is each sailor's part?
Ans. $24,93cts.

9. Three merchants, A, B, and C, have a ship in company; A has $\frac{5}{8}$, B $\frac{2}{8}$, and C $\frac{1}{8}$; they have received for freight £228 16s. 8d.; it is required to divide it among the owners, according to their respective shares: pray, can you do it? Ans. { A's share £143 5d. B's £57 4s. [illegible]d. C's £28 12s. 1d.

10. A privateer having taken a prize worth $6850, it is divided into one hundred shares; the captain takes 11; 2 lieutenants, each 5; 12 midshipmen, each 2; and the remainder is to be equally divided among the sailors, who are 105 in number;—pray can you settle the matter?
Ans. { Captain's share $753,50cts.; a lieut's $342,50cts.; a midshipm's $137; and a sailor's $$35,88\frac{10}{105}$cts.

11. Divide the sum of 50 eagles, 50 dollars, 50 dimes, 50 cents, and 60 mills among 17 men; and give the first 12 cents more than the second, the second 12 cents more than the third, and so on, to the last;—what will the seventeenth man's share be? Ans. $31,72cts.

NOTE.—It is customary among appraisers of property, arbitrators or referees, and, in some cases, the method is resorted to even by juries, where they cannot agree in their estimates and verdicts, to take the amount of the sums which they severally agree to award, and divide that amount by the number of which they consist; the quotient is their average judgment, which goes for their estimate, decision, or verdict.

EXAMPLES.

1. In appraising a certain property, *A* called the value $100, *B*, $140, *C*, $80, and *D*, $150; but as they could

not agree in their estimates, they determined to take their average judgment, and let that be the value; what was the value in that case.

A	$100
B	140
C	80
D	150
4	)470

$117,50c. Ans.

2. Four persons appraising a building, A valued it at $550,50c., B, at $480,50c. C, at $590,50c. and D, at $600; what was the mean value. Ans. $555,37½c.

3. Seth Strong, Luke Locke, Mark Mills, Charles Church, and John Jones, were appointed to appraise the Ship Ocean; Strong's estimate was $5500, Locke's $7000, Mills' $6666, Church's $8444, and Jones's, $5000; what was the mean judgment? Ans. $6522.

DUODECIMALS.

Duodecimals chiefly regard feet and inches. They are so called, because they decrease by twelves from the place of feet towards the right hand.

Inches are sometimes called primes, and marked thus ($'$); the next division is called parts or seconds, and marked ($''$); the next thirds, and marked ($'''$); &c.

MULTIPLICATION OF DUODECIMALS.

Rule.—Under the multiplicand write the corresponding denominations of the multiplier. Multiply each term in the multiplicand, beginning at the lowest, by the highest denomination in the multiplier; and write each result under its respective term; observing to carry a unit for every 12 from each lower place to its next higher.

In the same manner multiply all the multiplicand by the next highest denomination in the multiplier; and set

the result of each term removed one place to the right hand of those in the multiplicand.

Proceed in like manner with the remaining denominations, and the sum of all the lines will be the product required.

EXAMPLES.

1. Multiply 4 feet 2 inches by 3 feet 5 inches.

The 2 in the product is not 2 inches, but 2 twelfths of a square foot or 24 inches, &c.

Ft.	′	″	
4	2		
3	5		
12	6		
1	8	10″	
14	2	10	Ans. 14ft. 2′ 10″.

2. Multiply 10 feet 11 inches by 7 inches.

10	11		
	7		
6	4	5	Ans. 6ft. 4′ 5″.

3. What is the content of a bale 6 feet 5′ long; 4 feet 3′ high and 3 feet 10′ wide?

Ft.	′	″	‴	
6	5			
4	3			
25	8			
1	7	3		
27	3	3		
3	10			
81	9	9		
22	8	8	6	
104	6	5	6	Ans. 104ft. 6′ 5″ 6‴

4. What is the content of a marble slab 4ft. 7′ 8″ wide and 5ft. 6′ long? Ans. 25ft. 6′ 2″.

5. Multiply 7ft. 8′ 6″ by 10ft. 4′ 5″.
Ans. 79ft. 11′ 0″ 6‴ 6⁗.

6. Multiply 44ft. 2′ 9″ 2‴ 4⁗ by 2ft. 10′ 3″.
Ans. 126ft. 2′ 10″ 8‴ 10⁗ 11′′′′′.

7. How many square feet in a board 25 feet 6 inches long, and 1 foot 3 inches wide?
Ans. 31 feet 10½ inches.

8. How many cubic feet in a stick of timber 12 feet 10′ long, 1 foot 7′ wide, and 1 foot 9′ thick?
Ans. 35ft. 6′ 8″ 6‴.

9. How many cubic feet of wood in a load 7 feet 10′ long, 3 feet 11′ wide and 3 feet 6′ high?
Ans 107ft. 4′ 7″.

10. The length of a room being 20ft., its width 14ft. 6′, and height 10ft. 4′; how many yards of painting are in it, deducting a fire-place of 4ft. by 4ft. 4′, and two windows, each 6ft. by 3ft. 2′? Ans. 73 $\frac{2}{27}$ yards.

11. Required the solid contents of a wall 53ft. 6′ long, 10ft. 3′ high, and 2ft. thick. Ans. 1096ft. 9′.

FRACTIONS.

Fractions, or broken numbers, are expressions for any assignable parts of a unit, or whole number, and generally, are of two kinds, viz.

VULGAR AND DECIMAL.

A Vulgar Fraction is represented by two numbers, placed one above the other, with a little line drawn between them; thus, $\frac{3}{4}$, $\frac{5}{8}$, &c. signify three-fourths, five-eighths, &c.

The figure above the line, is called the numerator, and the one below the line the denominator.

$$\text{Thus}\begin{cases}5 \text{ Numerator.}\\ \text{—}\\ 8 \text{ Denominator.}\end{cases}$$

The denominator (which is the divisor, in division,)

shows how many parts the unit or integer is divided into; and the numerator (which is the remainder after division,) shows how many of those parts are meant by the fraction.

A fraction is said to be in its least or lowest terms, when it is expressed by the least numbers possible; thus $\frac{4}{8}$ when reduced to its lowest terms, will be $\frac{1}{2}$, and $\frac{9}{12}$ when expressed by the least numbers possible, will be $\frac{3}{4}$; and so of any others.

Problem 1.

To abbreviate or reduce fractions to their lowest terms.

Rule.—Divide the terms of the given fraction by any number which will divide them without leaving a remainder, and the quotients divide again in like manner; and so on till it appears that there is no number greater than 1, which will any longer divide them; and then the fraction will be in its lowest terms.

EXAMPLES.

1. Reduce $\frac{432}{720}$ to its lowest terms.
   $8)\frac{432}{720}=\frac{54}{90}$ $6)\frac{54}{90}=\frac{9}{15}$. $3)\frac{9}{15}=\frac{3}{5}$ the answer.
2. Reduce $\frac{162}{324}$ to its lowest terms. *Ans.* $\frac{1}{2}$
3. Reduce $\frac{216}{288}$ to its lowest terms. *Ans.* $\frac{3}{4}$
4. Reduce $\frac{45}{315}$ to its lowest terms. *Ans.* $\frac{1}{7}$
5. Abbreviate $\frac{66}{72}$ as much as possible. *Ans.* $\frac{11}{12}$
6. Bring $\frac{825}{960}$ to the least terms possible. *Ans.* $\frac{55}{64}$
7. Reduce $\frac{144}{216}$ to its lowest terms. *Ans.* $\frac{2}{3}$
8. Abridge $\frac{32}{256}$ as low as you can. *Ans.* $\frac{1}{8}$
9. Put $\frac{171}{180}$ into its least terms. *Ans.* $\frac{19}{20}$
10. Let $\frac{5184}{6912}$ be expressed in its least terms. *Ans.* $\frac{3}{4}$

Problem 2.

To find the value of a fraction in the known parts of the integer, as of coin, weight, measure, &c.

Rule.—Multiply the numerator by the common parts of the integer, and divide by the denominator, and the several quotients set in one line, will show the answer.

EXAMPLES.

1. What is the value of $\frac{2}{3}$ of a pound sterling?

Numer. 2
20 shillings in a pound.
—
Denom. 3)40(13s. 4d. the Ans.
3
—
10
9
—
1
12 pence in a shilling.
—
3)12(4d.
12
—

2. What is the value of $\frac{12}{13}$ of a pound sterling?
Ans. 18s. 5d. $2\frac{2}{13}$qrs.
3. Reduce $\frac{2}{5}$ of a shilling to its proper quantity.
Ans. 4d. $3\frac{1}{5}$qrs.
4. What is the value of $\frac{3}{8}$ of 12s. 6d.? Ans. 4s. $8\frac{1}{4}$d.
5. What is the value of $\frac{12}{16}$ of a pound Troy?
Ans. 9oz.
6. How much are $\frac{9}{11}$ of a hundred weight?
Ans. 3qr. 7℔. $10\frac{2}{11}$oz.
7. What is the value of $\frac{5}{6}$ of a mile?
Ans. 6fur. 26pol. 11ft.
8. How much are $\frac{7}{9}$ of a cwt., at 25℔ to a qr.?
Ans. 3qrs. 2℔. 12oz. $7\frac{1}{9}$dr.
9. Show the proper quantity of $\frac{5}{9}$ of an ell English?
Ans. 2qrs. $3\frac{1}{9}$na.
10. How much are $\frac{6}{7}$ of a hhd. of wine?
Ans. 54 gallons.
11. What is the value of $\frac{9}{13}$ of a day?
Ans. 16h. 36m. $55\frac{5}{13}$s.
12. What is the value of $\frac{4}{5}$ of a dollar? Ans. 80cts.

Problem 3.

To reduce any given quantity to the fraction of any greater denomination of the same kind.

Rule.—Reduce the given quantity to the lowest term mentioned, (as in reduction of Money, Weights, Meas-

ures, &c.) for a numerator; then reduce the integral part to the same term, for a denominator; place the former over the latter, and they will be the fraction required, which, if it be not in its lowest terms, must be reduced by Problem 1.

EXAMPLES.

1. Reduce 13s. 6d. 2qrs. to the fraction of a pound.

	s. d. qrs.	
20 shill. integral part.	13 6 2 given sum.	
12	12	
240	162	
4	4	
960 Denominator.	650 Numerator.	

Ans. $\frac{650}{960}=\frac{65}{96}$ £.

2. What part of a hundred weight are 3qrs. 14lb.? Ans. $\frac{98}{112}=\frac{7}{8}$.

3. What part of a yard are 3qrs. 3na.? Ans. $\frac{15}{16}$.

4. What part of a pound sterling are 13s. 4d.? Ans. $\frac{2}{3}$.

5. What part of a civil year are 3 weeks, 4 days? Ans. $\frac{25}{365}=\frac{5}{73}$.

6. What part of a mile are 6fur. 26pol. 3yds. 2ft.?

fur. pol. yds. ft. feet.
6, 26 3 2=4400 Num.
a mile=5280 Denom. Ans. $\frac{4400}{5280}=\frac{5}{6}$.

7. Reduce 7oz. 4dwt. to the fraction of a lb. Troy. Ans. $\frac{3}{5}$.

8. What part of an acre are 2 roods, 20 perches? Ans. $\frac{5}{8}$.

9. Reduce 54 gallons to the fraction of a hhd. of wine. Ans. $\frac{6}{7}$.

10. What part of a hogshead of wine are 9 gallons? Ans. $\frac{1}{7}$.

11. What part of a pound Troy are 10oz. 10dwt. 10gr.? Ans. $\frac{505}{576}$.

12. What part of a dollar are 80cts.? Ans. $\frac{4}{5}$.

DECIMAL FRACTIONS.

A Decimal is a fraction whose denominator is a unit, with as many ciphers annexed to it as the numerator has places; and is usually expressed by writing the numerator only with a point before it called the separatrix. Thus $\frac{5}{10}$, $\frac{25}{100}$, $\frac{236}{1000}$, are decimal fractions, and are expressed by ,5 ,25 ,236 respectively.

The place of a figure in decimals, as in whole numbers, determines its relative value: That in the first place next the separatrix is 10th parts: that in the second, 100th parts, &c. decreasing in the same tenfold proportion to the right hand, as whole numbers increase decimally from units to the left hand.

Ciphers placed at the right hand of decimals, make no alteration in their value; for ,5 ,50 ,500, &c. are decimals of the same value, being each equal to $\frac{1}{2}$; but if placed at the left hand, the value of the fraction is decreased in a tenfold proportion for every cipher prefixed; thus ,5 ,05 ,005, &c. are 5 tenth parts, 5 hundredth parts, and 5 thousandth parts respectively. In the following Table, the doctrine is exemplified at large.

NUMERATION TABLE, OR SCALE OF NOTATION.

Millions.	C of Thousands.	X of Thousands.	Thousands.	Hundreds.	Tens.	Units.	Tenth parts.	Hundredth parts.	Thousandth parts.	XThousandth parts.	CThousandth parts.	Millionth parts.
7	6	5	4	3	2	1,	2	3	4	5	6	7
WHOLE NUMBERS.							DECIMALS.					

ADDITION OF DECIMALS.

Rule.—Set the numbers so that the decimal points may stand directly under each other, then add as in whole numbers, carrying one for every ten, and place the deci-

mal point, in the sum, directly under the decimal points of the numbers which have been added.

EXAMPLES.

£	$
124,6201	3741,21
5,92	374,646
17,1174	8,46
305,2165	52117,42
2,71	91,5
455,5840	

In this first example, the sum is 455 integers, or pounds, and $\frac{584}{1000}$ parts of a unit or pound; or it is 455 units, and 5 tenth parts, 8 hundredth parts, and 4 thousandth parts of a unit, or 1; the cipher at the right of the decimal places does not affect the value of the other figures, and it is, therefore, thrown away.

Hence we may observe, that decimals, and Federal Money, are subject to one and the same law of notation, and, consequently, of operation.

For since 1 dollar is the money unit, and a dime being the tenth, a cent the hundredth, and a mill the thousandth part of a dollar, it is evident that any number of dollars, dimes, cents, and mills, is simply the expression of dollars, and decimal parts of a dollar: thus, 11 dollars, 6 dimes, 5 cents = 11,65 or $11\frac{65}{100}$ dol. &c.

3. What is the sum of 276,+39,213+72014,9+417,+ 5032, and+2214,298 acres? *Ans.* 79993,411 acres.

4. What is the sum of ,014+,9816+,32+,15914+ ,72913+,0047 gallons? *Ans.* 2,20857gal.

5. What is the sum of 27,148+918,73+14016,+294,04, +7138, and +221,7 bushels? *Ans.* 316625,578bus.

6 Add the following sums of dollars together, viz. $12,34565+7,891+2,34+14,+,0011.

Ans. $36,57775 or $36, 5di. 7cts. $7\frac{75}{100}$mills.

7. To 9,999999 miles add one millionth part of a mile. *Ans.* 10 miles.

SUBTRACTION OF DECIMALS.

RULE.—Set the less number under the greater in the same manner as in addition; then subtract as in whole numbers, and place the decimal point in the remainder directly under the other points.

EXAMPLES.

$.	£.	yds.
612,32	16,279	37,
51,0942	8,0917	2,41
561,2258		

4. From ,9173ft. subtract ,2138. Ans. ,7035 foot.
5. From $2,73 subtract $1,9185. Ans. $,8115.
6. Subtract 91,713 acres from 407. Ans. 315,287ac.
7. What is the difference between 67 tons and ,92 of a ton? Ans. 66,08 tons.
8. From 1 league subtract the millionth part of itself. Ans. ,999999 league.

MULTIPLICATION OF DECIMALS.

RULE.—Place the factors, (whether mixed numbers, or pure decimals,) and multiply them, as in whole numbers; and from the product, towards the right hand, point off as many figures for decimals as there are decimal places in the factors. But if there be not so many figures in the product, prefix ciphers to supply the defect.

EXAMPLES.

1.	2.
21,41 yards.	,2616 ℔.
25,9 shillings.	,154 doll.
19269	10464
10705	13080
4282	2616
554,519 shill. Ans.	,0402864 doll. Ans.

3. Multiply 31,72 rods by 65,3. Prod. 2071,316 rods.
4. Multiply ,62 foot by ,04. Prod. ,0248 foot.
5. Multiply 51,6 yards by 21. Prod. 1083,6 yards.
6. Multiply ,051£ by ,0091. Prod. ,0004641£.
7. What cost 6,21 yards of cloth, at 2 dollars, 32 cents, 5 mills per yard? Ans. $14 4d. 3c. $8\frac{25}{100}$m.
8. Multiply 7,02 dollars by 5,27 dollars. Ans. 36,9954 dolls. or $36,99cts. $5\frac{4}{10}$m.
9. Multiply 41dols. 25cts. by 120dols. Ans. $4950.
10. Multiply 3 dollars, 45 cents, by 16 cents. Ans. ,5520, or 55 cents, 2 mills.
11. Multiply 65 cents by ,09 or 9 cents. Ans. ,0585=5 cents, $8\frac{1}{2}$ mills.
12. Multiply 10 dollars by 10 cents. Ans. $1.
13. Multiply 341,45 dollars by ,007 or 7 mills. Ans. $2,39.+

NOTE.—To multiply Decimal Fractions by 10, 100, 1000, &c. is only to remove the separatrix so many places towards the right hand, as there are ciphers in the multiplier.

EXAMPLES.

1. Multiply $64,674 by $10. Ans. $646,74.
2. Multiply $3,2158 by 1000 cords. Ans. $3215,8.

DIVISION OF DECIMALS.

RULE.—Divide as in whole numbers; and observe the following rules for pointing off in the quotient.

1. Point off for decimals in the quotient so many figures, as the decimal places in the dividend exceed those in the divisor.

2. If the figures in the quotient are not so many as the rule requires, supply the defect by prefixing ciphers.

3. If the decimal places in the divisor be more than those in the dividend, add ciphers as decimals to the dividend, until the number of decimals in the dividend be equal to those in the divisor, and the quotient will be integers until all these decimals are used. And in case of a remainder, after all the figures of the dividend are used, and more figures are wanted in the quotient, annex ci-

phers to the remainder, to continue the division as far as necessary.

4. The first figure of the quotient will possess the same place of integers or decimals, as that figure of the dividend which stands over the unit's place of the first product.

EXAMPLES.

1. Divide 3424,6056 by 43,6.

Divisor. Dividend. Quotient.

```
43,6)3424,6056(78,546
     3052
     ----
      3726
      3488
      ----
       2380
       2180
       ----
        2005
        1744
        ----
         2616
         2616
         ----
```

Or,—What is potash per ton, when 43 tons, 12cwt. cost $3424,6056?
Ans. $78,54c. 6m.

2. Divide 761,2 miles by 2,1942 weeks.
2,1942)761,2000(346,91 miles, and 10078 rem.

3. Divide 7,735 rods by 3,25. Ans. 2,38 rods.
4. Divide 3877875£ by ,675. Ans. 5745000£.
5. Divide 1835,78 tons by 7,48. Ans. 245,42 tons.+
6. Divide ,55736 cord by 48. Ans. ,01161 cord.+
7. Divide 7,13 acres by ,18. Ans. ,396 acre.+
8. Divide 246,1476 dollars by 604,25 dollars.
Ans. ,40736 dollars.+
9. Divide 186513,239 dollars by 304,81 dollars.
Ans. 611,9 dollars.+
10. Divide 1,28 dollars by 8,31 dollars.
Ans. ,154=15 cents, 4 mills.+
11. Divide 56cts. by 1dol. 12cts. Ans. 5 dimes or 50cts.
12. Divide 1 dollar by 12 cents.
Ans. 8,333 dollars, or $8,33 cents, 3 mills.+

13. If $21\frac{3}{4}$, or 21,75 yards of cloth cost 34,517 dollars, what is the price of one yard? *Ans.* 1,586 dollars.+

NOTE.—When decimals or whole numbers, are to be divided by 10, 100, 1000, &c. (viz. unity with ciphers,) it is performed by removing the separatrix in the dividend, so many places towards the left hand, as there are ciphers in the divisor.

EXAMPLES.

$748 divided by	10	the quotient is	74,8 dollars.
	100	- -	7,48 dollars.
	1000	-	,748 dollars.

REDUCTION OF DECIMALS.

CASE I.

To reduce a Vulgar Fraction to its equivalent decimal.

RULE.—Divide the numerator by the denominator, annexing as many ciphers as are necessary; and the quotient will be the decimal required.

EXAMPLES.

1. Reduce $\frac{5}{24}$ to a decimal.

```
24)5,0000(,20833+Ans.
   48
   ---
   200
   192
   ---
    80
    72
   ---
    80
    72
   ---
     8 Remainder.
```

2. Required the equivalent decimal expressions for $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$. *Ans.* ,25 ,5 and ,75.

3. Reduce $\frac{3}{8}$ to a decimal. *Ans.* ,375.

4. Reduce $\frac{1}{25}$ and $\frac{11}{27}$ to decimals. *Ans.* ,04 and ,407.+

5. Reduce $\frac{22}{25}$ and $\frac{1}{145}$ to decimals.
Ans. ,88 and ,00689.+

CASE II.

To reduce numbers of different denominations to their equivalent decimal values.

RULE 1.—Write the given numbers perpendicularly under each other for dividends, proceeding orderly from the least to the greatest.

2. Opposite to each dividend, on the left hand, place such a number for a divisor, as will bring it to the next superiour denomination, and draw a line between them.

3. Begin with the uppermost, and write the quotient of each division, as decimal parts, on the right hand of the dividend next below it; and so on until they are all used, and the last quotient will be the decimal sought.

EXAMPLES.

1. Reduce 15s. 9¾d. to the decimal of a pound.

4	3,
12	9,75
20	15,8125
	,790625 the decimal required.

2. Reduce 19s. to the decimal of a pound.
Ans. ,95.

3. Reduce 10s. 9d. 1qr. to the decimal of a pound.
Ans. ,5385416.+

4. Reduce 1d. 2qrs. to the decimal of a shilling.
Ans. ,125.

5. Reduce 10oz. 18dwt. 16grs. to the decimal of a ℔. Troy.
Ans. ,911111.+

6. Reduce 10oz. 14drs. to the decimal of a hundred weight.
Ans. ,0060686.+

7. Reduce 3 rods, 2½feet, 6 inches, to the decimal of a mile.
Ans. ,00994318.+

8. Reduce 1 pint to the decimal of a gallon.
Ans. ,125.

9. Reduce 2 months, 2 weeks, 2 days, to the decimal of a year.
Ans. ,197802.+

10. Reduce 3s. 4d. New-England currency, to the decimal of a dollar. Ans. ,555555.+

CASE III.

To reduce any number of shillings, pence and farthings, by inspection to the decimal of a pound.

RULE.—Write half the greatest even number of shillings for the first decimal figure, and let the farthings in the given pence and farthings possess the second and third places; observing to increase the second place by 5, if the shillings be odd; and the third place by 1 when the farthings exceed 12, and by 2, when they exceed 36.

EXAMPLES.

1. Find the decimal of 15s. 8½d. by inspection.

,7=½ of 14s.
,05 for the odd shilling.
,034=farthings in 8½d.
,001 for excess above 12.

,785=decimal required.

2. Find by inspection the decimal of 12s. 6¾d. Ans. ,628.

3. Find by inspection the decimal of 18s. 10¼d. Ans. ,943.

4. Find by inspection, and add together the decimal of 13s. 6d., 9s., 1s. 9d., 5d. ¾, and 1½d. Ans. £1,242.+

CASE IV.

To find the value of any given decimal in terms of the integer.

RULE 1.—Multiply the decimal by the number of parts in the next less denomination, and cut off as many places for a remainder on the right hand, as there are places in the given decimal.

2. Multiply the remainder by the parts in the next inferiour denomination, and cut off for a remainder as before.

3. Proceed in this manner through all the parts of the integer, and the several denominations, standing on the left hand, will make the answer.

EXAMPLES.

1. What is the value of ,7426 of a pound?

```
     ,7426
        20
   -------
s. 14,8520
        12
   -------
d. 10,2240
         4
   -------
     ,8960   Ans. 14s. 10¼d.+
```

2. What is the value of ,384 of a shilling? Ans. 4½d.+
3. What is the value of ,6725cwt., at 25lb. a qr.?
Ans. 2qrs. 17lb. 4oz.
4. What is the value of ,61 of a tun of wine?
Ans. 2hhds. 27gal. 2qts. 1pt.+
5. What is the value of ,25 of an hour?
Ans. 15 minutes.
6. What is the value of ,857 of a day?
Ans. 20h. 34m. 4s.+
7. What is the value of ,125 of a gallon?
Ans. 1 pint.

CASE V.

To find the value of any decimal of a pound by inspection.

RULE.—Double the first figure or place of 10ths for shillings, and if the second be five, or more than 5, add another shilling, then call the figures in the second and third places, after the 5 (if contained) is deducted, farthings; abating 1 if their number is more than 12, and 2 if more than 36; the result will be the answer.

EXAMPLES.

1. Find the value of ,785£ by inspection.

```
14s.=double 7.
  1s. for 5 in the place of 10ths.
    8¾=35 farthings.
     ¼ abated for the excess above 12.
-------
15s. 8½d.  Answer.
```

2. Find the value of ,976£ by inspection.

Ans. 19s. 6¼d.

3. Find the value of ,542£ by inspection.

Ans. 10s. 10d.

4. Find by inspection and add together the values of ,252£, ,875£, ,096£, ,763£, and ,008£.

Ans. £1 19s. 10½d.

REDUCTION OF CURRENCIES.

CASE I.

To reduce the currencies of the several United States, where a dollar is an even number of shillings, to Federal Money.

RULE 1.—When the sum consists of pounds only, annex a cipher to it, and divide by half the number of shillings in a dollar; and the quotient will be dollars; if there be a remainder, annex ciphers to it, and divide again, by which you will get the cents, &c.

2. But if the sum consists of pounds, shillings, pence, &c. bring it into shillings, and reduce the pence and farthings to a decimal of a shilling; annex said decimal to the shillings, with a decimal point between; then divide the whole by the number of shillings contained in a dollar, and the quotient will be dollars, cents, mills, &c.

EXAMPLES.

1. Reduce £73 New-England, Virginia, &c. currency, to Federal Money.

3)730

\$243,33⅓cts. Ans.

2. Reduce £45 15s. 7½d. New-England currency, to Federal Money.

20		
s.	d.	½d.=,5
A dollar=6)915, 625	12)7,500	
		d.
\$152, 604+ Ans.	,625 decimal=7½	
c. m.		

3. Reduce £105 14s. 3¾d. New-York and North-Carolina currency, to Federal Money.

£.	s.	d.	
105	14	3¾	¾=,75 of a penny.
20			d.
s.			12)3, 7500

A dollar=8)2114, 3125 ————— d.
,3125 deci.=3¾

$\$264, 289\frac{06}{100}+$ Ans.
c. m.

4. Reduce £431 New-York currency, to Federal Money.

4)4310

$1077, 50cts. Ans.

Rule 2.—Bring the given sum into a decimal expression by inspection, as in Case 3 of decimal fractions; then divide the whole by ,3 in New-England, &c. currency, and by ,4 in New-York, &c. currency; and the quotient will be dollars, cents, &c.

EXAMPLES.

1. Reduce £54 8s. 3½d. New-England currency, to Federal Money.
£.
,3)54,415 decimally expressed.

$181,38c.+ Ans.

2. Reduce 7s. 11¾d. New-England currency, to Federal Money.

7s. 11¾d.=£0,399 decimally expressed.
Then ,3),399

$1,33c. Ans.

3. Reduce £513 16s. 10d. New-York, &c. currency, to Federal Money.
£.
,4)513,842 decimally expressed.

$1284,60½c. Ans.

4. Reduce 19s. $5\frac{3}{4}$d. New-York, &c. currency, to Federal Money.

£.
,4)0,974 decimal of 19s. $5\frac{3}{4}$d.

\$2,$43\frac{1}{2}$c. Ans.

NOTE.—By the preceding rule, you may carry on the decimal to any degree of exactness; but in ordinary practice, the following *Contraction* may perhaps be useful.

RULE 3.—To the shillings contained in the given sum, annex 8 times the given pence, increasing the product by 2; then divide the whole by the number of shillings contained in a dollar, and the quotient will be cents.

EXAMPLES.

1. Reduce 45s. 6d. New-England, &c. currency, to Federal Money.

s. $\overline{6\times8}+2=50$ to be annexed.
6)45,50

\$7,$58\frac{2}{6}$c. Ans. or 6)4550

\$ c.
758+ cents=7,58

2. Reduce £2 10s. 9d. New-York, &c. currency, to Federal Money. £2 10s.=50s.

$\overline{9\times8}+2=74$ to be annexed.
Then 8)5074

\$ c.
634+cents=6,34

s.
Or thus 8)50,74

\$6,$34\frac{1}{4}$c. Ans.

NOTE.—When there are no pence given in the sum, you must annex two ciphers to the shillings; then divide as before, &c.

3. Reduce £3 5s. New-England currency, to Federal Money.

£3 5s.=65s. Then 6)6500

\$ c.
$1083\frac{1}{3}$cts.=10,$83\frac{1}{3}$ *Ans.*

CASE II.

To reduce the currency of New-Jersey, Pennsylvania, Delaware, and Maryland, to Federal Money.

RULE.—Multiply the given sum by 8, and divide the product by 3, and the quotient will be dollars, &c.

EXAMPLES.

1. Reduce £245 New-Jersey, &c. currency, to Federal Money.

£245×8=1960, & 1960÷3=\$653$\frac{1}{3}$=\$653,33$\frac{1}{3}$c. Ans.

NOTE.—When there are shillings, pence, &c. in the given sum, reduce them to the decimal of a pound, then multiply and divide as in the preceding question.

2. Reduce £36 11s. 8$\frac{1}{2}$d. New-Jersey, &c. currency, to Federal Money.

$$\begin{array}{r} £36,5854 \text{ decimal value.} \\ 8 \\ \hline 3)292,6832 \\ \hline \$97,561\frac{06}{100}+ \text{ Ans.} \\ \text{c. m.} \end{array}$$

3. Reduce 17s. 9d. New-Jersey, &c. to Federal Money. Ans. \$2,36c. 6$\frac{2}{3}$ mills.

CASE III.

To reduce the currency of South-Carolina, and Georgia, to Federal Money.

RULE.—Multiply the given sum by 30, and divide the product by 7; the quotient will be dollars, cents, &c. Or, multiply by 3 and divide by ,7.

EXAMPLES.

1. Reduce £100 South-Carolina and Georgia currency, to Federal Money.

£100×30=3000; 3000÷7=\$428,5714+ Ans.

2. Reduce £54 16s. 9¾d. Georgia currency, to Federal Money.

54,8406 decimal expression.
30

7)1645,2180

$235,0311+ Ans.

3. Reduce 11s. 6d. South-Carolina, &c. to Federal Money. Ans. $2 46c. 4m.+

CASE IV.

To reduce the currency of Canada and Nova-Scotia, to Federal Money.

Rule.—Multiply the given sum by 4, if it contain pounds only, and the product will be dollars. If it contain shillings, reduce the whole to shillings, and divide by 5; if it contain pence, reduce the whole to pence, and divide by 60; and the quotient, in either case, will be dollars; to the remainders, if there be any, annex ciphers, and continue the division, by which you will obtain the cents and mills.

Or, when the given sum contains shillings, pence, &c. reduce them to the decimal of a pound, annex the decimal to the pounds, and multiply the whole by 4; the product will be dollars, cents, &c.

EXAMPLES.

1. Reduce £125 Canada and Nova-Scotia currency, to Federal Money.

125
4

$500 *Ans.*

2. Reduce £68 14s. Nova-Scotia currency, to Federal Money.

£. s.
68 14
20

5)1374

$274,80cts. Ans.

Or,

£.
68, 7 decimal expression.
4

$274,8 dimes. *Ans.*

3. Reduce £45 17s. 9d. Canada and Nova-Scotia currency, to Federal Money.

£. s. d.
45 17 9
20
———
917
12
———
6,0)1101,3
———
$183,55cts. Ans.

£.
Or, 45,8875 decimal expression.
4
————
$183,5500
c.

4. Reduce £58 13s. $6\frac{1}{2}$d. Canada, &c. to Federal money.

£. s. d.
58 13 $6\frac{1}{2}$ $\frac{1}{2}$=,5 of a penny.
20
———
1173
12
———
6,0)$1408,2\frac{5}{10}$
———
$$234,708\frac{1}{3}$ Ans.
c. m.

£.
Or, 58,67708 decimal expression.
4
————
\$. c. m.
$234,70832=$234,70,8\frac{32}{100}$+ Ans.

5. Reduce £528 17s. 8d. Canada, &c. to Federal Money. Ans. $2115,53cts.+

6. Reduce £1 2s. 6d. Nova-Scotia, &c money, to Federal Money. Ans. $4,50cts.

7. Reduce 13s. $11\frac{1}{2}$d. Nova-Scotia, &c. money, to Federal Money. Ans. $2,79cts.+

CASE V.

To reduce the money of Great Britain to Federal Money.

Rule.—If the given sum be pounds only, multiply by 40, and divide by 9, or multiply by 4, and divide by ,9; the quotient will be dollars; if there be any remainder, annex ciphers to it, and continue the division; the quotient will be cents, &c. But if it consist of pounds and shillings, reduce it to shillings, then double them, and divide as before. And if it contain pounds, shillings, and

pence, reduce it to pence, and divide by 54, the number of pence in a dollar.

Or, when the sum consists of pounds, shillings, and pence, reduce the shillings, &c. to the decimal of a pound, then multiply the whole by 40, and divide by 9.

EXAMPLES.

1. Reduce £36 sterling into Federal Money.

$$\frac{36\times40}{9}=\$160 \text{ Ans.}$$

2. Reduce £36 9s. sterling into Federal Money.

£. s.	£.
36 9	Or, 36,45 decimal expression.
20	40
729	9)1458,00
2	$162 Ans.
9)1458 doubled.	
$162 Ans.	

3. Reduce £579 17s. 9d. sterling into Federal Money.

£. s. d.	£
579 17 9	Or, 579,8875 decimal expression.
20	40
11597	
12	9)23195,5000

$. c. m.
54)139173(2577,277+An.$2577,2777+ Ans.

4. Reduce £100 sterling money, to Federal Money.
Ans. $444,44$\frac{4}{9}$c.

To reduce Federal Money to the currency of

1. *New-England, Virginia, Kentucky,* and *Tennessee.* Rule. Multiply the given sum by ,3 and the product will be pounds, and decimals of a pound.

2. *New-York,* and *North Carolina.* Rule. Multiply the given sum by ,4 and the product will be pounds, and decimals of a pound.

3.	*New-Jersey, Pennsylvania, Delaware,* and *Maryland.*	Rule.	Multiply the given sum by 3, and divide the product by 8, and the quotient will be pounds and decimals of a pound.
4.	*South Carolina & Georgia.*	Rule.	Multiply the given sum by ,7 and divide the product by 3, and the quotient will be pounds and decimals of a pound.

EXAMPLES IN THE FOREGOING RULES.

1. Reduce \$152,60cts. to New-England currency.

```
   152,60
       ,3
   ------
 £45,780  Ans. £45 15s. 7d. 2/10.
       20 But the value of any decimal of a pound,
   ------ may be found by inspection, as in Case 5
s. 15,600 of Decimal Fractions, page 87.
       12
   ------
d. 7,200
```

2. Reduce \$196 into Virginia, &c. currency.

```
   196
    ,3
   ---
£58,8 Ans.=£58 16s.
```

3. In \$629, how many pounds New-York, &c. currency?

```
    629
     ,4
    ---
£251,6 Ans.=£251 12s.
```

4. Bring \$110,51cts. into New-Jersey, &c. currency.

```
   110,51
        3 Double ,4=8s.  Then take 2 from 41=39
   ------ for farthings=9d. 3qrs.  See Case 5 of
8)331,53  Decimals, page 87.
   ------
£41,441  Ans.=£41 8s. 9¾d. by inspection.
```

5. How many pounds, &c. South-Carolina, &c. currency, in $65,36cts. 8mills?

$$
\begin{array}{r}
65,368 \\
,7 \\
\hline
3)45,7576 \\
\hline
£15,25253
\end{array}
$$

Ans.=£15 5s. 0½d.

CASE II.

To reduce Federal Money to Canada and Nova-Scotia currency.

Rule.—Divide the dollars by 4, and the quotient will be pounds; to the remainder, if there be any, annex the cents, &c. and to that number annex a cipher; then halve that number, and cut off the *left* hand figure or figures less than 20, for shillings; the remaining figure or figures multiply by 12, and cut off just as many *right* hand figures from the product as you multiply; the left hand ones are pence, &c.

Or, multiply the given sum by 60, the number of pence in a dollar, and if it contains cents, cut off two figures on the right, if mills, three; those on the left are pence, which must be reduced into pounds. The figures cut off will be decimals of a penny.

Or, lastly, divide the given sum by 4, and the quotient will be pounds, and decimals of a pound.

EXAMPLES.

1. Reduce $183,55cts. into Canada and Nova-Scotia Money.

$$
\begin{array}{r}
\$ \\
4)183 \\
\hline
£45
\end{array}
$$

—and 3 remain to be placed before the 55 cents., 355, to which annex a cipher. 3550 halved, or divided by 2=1775, of which cut off the two left hand figures, as they are less than 20, which are shillings 17,75 75×12=900, of which cut off the two right hand figures because you multiply two=9,00; and the 9 on the left are pence; the answer is, therefore, £45 17s. 9d.

By the second method: 183,55×60=1101300, from which cut off the two right hand figures, and it is 11013, which are pence. These reduced, are £45 17s. 9d. Ans.

By the last method: $. c.
4)183,55
£45,8875=£45 17s. 9d. *Ans.*

2. Bring $741 into Nova-Scotia currency.
Ans. £185 5s.

3. What sum, Nova-Scotia money, is equal to $311, 75cts.? Ans. £77 18s 9d.

4. In $2907,56cts., how much Nova-Scotia money?
Ans. £726 17s. 9½d.+

5. How many pounds, &c. Canada money are in $2114,50cts.? *Ans.* £528 12s. 6d.

CASE III.

To reduce Federal Money to the money of Great Britain.

RULE.—Multiply the given sum by 9, and divide the product by 40; or multiply the given sum by ,9 and divide the product by 4; and, in either case, the quotient will be the answer in pounds, and decimals of a pound.

EXAMPLES.

1. Reduce $183,55cts. into sterling money.

```
     183,55
          9
    -------        Or 183,55
  4,0)165,195              ,9
    -------           -------
   £41,29875        4)165,195
          20         --------
    --------      £41,29875= £41 5s. 11½d. by inspection.
  s. 5,97500
          12
     -------
  d. 11,700
          4
     ------
  qrs. 2,8    £41 5s. 11d. 2,8qrs. Ans.
```

2. Bring $247,44c. 5m. into English money.
Ans. £55 13s. 6$\frac{3}{100}$d.

3. Show the value of $1000 in British money.
Ans. £225.

4. Tell me what sum, in sterling money, is just equal to $2466,33cts. $3\frac{1}{8}$mills. *Ans.* £554 18s. 6d.

RULE OF THREE.

The Rule of Three teaches to find a number having the same proportion to a given number, that two other given numbers have between themselves. For this reason it is sometimes called the Rule of Proportion. It is called the Rule of Three, because in each of its questions there are given three numbers at least. And because of its excellent and extensive use, it has been often named the *Golden Rule.*

Rule.—Write down the number, which is of the same kind with the answer or number required.

Consider whether the answer ought to be greater or less than this number; if greater, write the greater of the two remaining numbers on the right hand of it for the third, and the other on the left for the first number or term; but if it ought to be less, write the less of the two remaining numbers in the third place, and the other in the first.

Multiply the second and third terms together, divide the product by the first, and the quotient will be the answer.

Note 1.—It is sometimes most convenient to multiply and divide as in Compound Multiplication and Division. But when it is not, then reduce each of the compound terms, to the lowest denomination mentioned in it, and reduce the first and third to the same denomination; then will the answer be of the same denomination with the secoud term. And the answer may afterwards be brought to any denomination required.

2. When there happens to be a remainder after the division, reduce it to the name next below the last quotient, and divide by the same divisor; so shall the quotient be so many of the said next denomination; do this as long as there is any remainder, or till you have reduced it to the least name, and all the quotients together will be the answer.

3. If the first term, and either the 2d or 3d, can be divided by any number, without remainder, let them be divided, and the quotients used instead of them.

4. There are four other methods of operation besides the general one above delivered, any of which, when possible, performs the work much shorter than it. They are thus:

First, Divide the 2d term by the 1st, multiply the quotient by the 3d, and the product will be the answer.

Second, Divide the 3d term by the 1st, multiply the quotient by the 2d, and the product will be the answer.

Third, Divide the 1st term by the 2d, divide the 3d by the quotient, and the last quotient will be the answer.

Fourth, Divide the 1st term by the 3d, divide the 2d by the quotient, and the last quotient will be the answer.

Two or more statings are sometimes necessary, which may always be known from the nature of the question.

The method of proof is by inverting the question.

EXAMPLES.

1. What is the value of 2℔. 6oz. 19dwt. of gold, at £3 19s. 11d. an ounce?

oz.		£. s. d.		℔. oz. dwt.
1	:	3 19 11	: :	2 6 19
20		20		12
20		79		30
		12		20
		959		619
		619		
		8631		
		959		
		5754		

2,0)59362,1

12)29681$\frac{1}{20}$ Pence, which divided by 12 and 20, gives the answer in pounds, &c.

2,0)247,3s. 5d.

Ans. £123 13s. 5$\frac{1}{20}$d.

2. If 9℔. of tobacco cost 1 dollar 20 cents, what will 25℔. cost?

```
℔.        $. cts.        ℔.
9    :    1,20    : :    25
                         120
                        ----
                       9)3000
                        ----
                       $3,33⅓ Ans.
```

3. If 25℔. of tobacco cost $3,33⅓, what will 9℔. cost?

```
℔.        $. cts.        ℔.
25   :    3,33⅓   : :    9
             9
          -----
         25)3000(120 cents, or $1,20 the An.
            25
            --
             50
             50
             --
              0
```

4. What is the value of a firkin of butter containing 56℔. at 10½d. per pound?

```
℔.        d. qrs.        ℔.
1    :    10 2    : :    56
               8
56=7×8 -------
       s. 7 0 0
              7
       --------
     £2 9 0 0 the Answer.
```

5. If 7cwt. 1qr. of sugar cost 36dols. 10c., what will be the price of 43cwt. 2qr.? Ans. $216,60c.

```
cwt.qr.      $. cts.        cwt. qr.
7   1   :    36,10    : :   43   2
4            17  4          4
--           -----          ---
29           1444           174
            2527
            361
            -------
        29)628140(21660cts.=$216, 60cts.
```

6. If 6 horses eat 21 bushels of oats in a month, how many bushels will 20 horses eat in the same time?

Hor.		*Bus.*		*Hor.*		*Bus.*
6	:	21	: :	20	:	70 Ans.

7. A man bought sheep at 1dol. 11cts per head, to the amount of 51dol. 6cts: how many sheep did he buy?

\$ cts.		sh.		\$ cts.		sh.
1,11	:	1	: :	51,06	:	46 Ans.

8. What is the value of an cwt. of sugar at $5\frac{1}{2}$d. per ℔., 25℔. a qr.?

℔.		d. qr.		℔.		£. s. d.
1	:	5 2	: :	100	:	2 5 10 Ans.

9. How much in length of that which is $4\frac{1}{2}$ inches broad will make a square foot?

Breadth.		*Length.*		*Breadth.*		*Length.*
$4\frac{1}{2}$	:	12	: :	12	:	2ft. 8in. Ans.

10. Bought 6 casks of raisins, each weighing 1cwt. 1q. $12\frac{1}{2}$lb.; what will they come to at £2 1s. 8d. per cwt.?

Cwt.		£ s. d.		Cwt. qr. ℔.		£ s. d.
1	:	2 1 8	: :	1 1 $12\frac{1}{2}$+6	:	17 0 $4\frac{3}{4}$+Ans.

11. If a man spend 2 dollars 45 cents a week, what will it amount to in a year?

days.		\$. cts.		days		\$. cts.
7	:	2,45	: :	365	:	127,75 Ans.

12. What is the value of a pipe of wine at $10\frac{1}{2}$d. per pint?

Pint.		d.		Pipe.		£. s.
1	:	$10\frac{1}{2}$	: :	1	:	44 2 Ans.

13. How many quarters of corn can I buy for 280 dollars, at $\frac{2}{3}$ of a dollar per bushel?

Ans. 52 quarters, 4 bushels.

14. What is the value of 2qrs. 1na. velvet, at 19s. $8\frac{1}{2}$d. per ell English? Ans. 8s. $10\frac{1}{4}$d. $\frac{7}{10}$.

15. Suppose 18 yards of broadcloth $1\frac{1}{2}$yds. wide is to be lined with shalloon that is $\frac{3}{4}$ of a yard wide; how many yards of shalloon will be sufficient? Ans. 36yds.

16. If 52 yards of cloth cost 156 dollars, how much will 4 yards cost? *A*ns. 12 dollars.

17. Bought 36 yards of cloth for 108 dollars, and sold the same at $3\frac{1}{2}$ dollars per yard; how much did I gain?

*A*ns. 18 dollars.

18. If 7yds. of ribbon cost 3s. 4d., what will 126yds. cost? *Ans.* £3.

19. If a man earn 64 dollars in 4 months, how long must he work at the same rate to pay a debt of 300 dollars? *Ans.* 18 months, 3 weeks.

20. If an ounce of silver be worth 1 dollar 10 cents, what is the value of 10 silver spoons, each weighing 1oz. 4 pennyweights? *Ans.* 13 dolls. 20cts.

21. If $8\frac{3}{4}$ yards cost 4 dollars 20 cents, what will $13\frac{1}{2}$ yards cost? *Ans.* 6doll. 48cts.

22. How long will it take 5 men to do the same work which 37 men can do in 15 days? *Ans.* 111 days.

23. What will 4 hogsheads of wine come to containing, viz. $79\frac{1}{2}$, $84\frac{1}{4}$, $101\frac{1}{4}$, and 112 gallons, at 6s. 9d. per gallon? *Ans.* £127 4s. 9d.

24. Bought 3hhds. of sugar, each weighing 8cwt. 1qr. 12lb. at 7dolls. 26cts. per cwt; what come they to, 25lb. to the qr? *Ans.* \$182,29c. $8\frac{3}{5}$m.

25. If a chest of hyson tea weighing 79lb. neat, cost £32 11s. 9d., what is it per pound? *Ans.* 8s. 3d.

26. B owes £2119 17s. 6d., and he is worth but £1324 18s. $5\frac{1}{4}$d.; if he delivers this to his creditors, how much do they receive on a pound? *Ans.* 12s. 6d.

27. A merchant failing in trade, owes in all 29475 dollars, and delivers up his whole property worth 21894 dollars, 3 cents; how much per cent. does he pay; and what is B's loss to whom he owed 325 dollars?

Ans.—He pays \$74,28cts. per cent.
and B loses \$83,59cts.

28. If a staff, 4 feet, 8 inches in length, cast a shadow 6 feet; how high is that steeple whose shadow is 153 feet? *Ans.* 119 feet.

29. Bought 270 quintals codfish for 780 dollars; freight 37 dollars, 70cts.; wharfage, truckage and other expenses 30 dollars, 60cts.; at what must I sell them per quintal, so as to gain 143 dollars on the whole?

Ans. \$3,67cts. 1m.+

30. If $\frac{3}{5}$ of a farm cost \$1081, what is the whole worth?

fif.	\$.		fif.	\$. cts. m.
3 :	1081	: :	5 :	1801,66 6+*Ans.*

31. If a man spend 46 cents a day, what will it amount to in a year? Ans. $167,90c.

32. Lent a friend 292 dollars for six months; sometime afterward he lent me 403 dollars; how long must I keep it to balance the favour? Ans. 4m. 1w. 2d.+

33. If 100 dollars gain 6 dollars interest in one year, how much will 480 dollars gain in the same time?

Ans. $28,80c.

34. If 480 dollars, gain 28 dollars, 80 cents in one year, how much will it gain in 87 days?

Ans. $6,86cts. 4m.+

35. How much land, at 2 dollars, 50 cents per acre, must be given in exchange for 360 acres, at 3 dollars, 75 cents per acre? *Ans.* 540 acres.

36. Bought a silver cup weighing 9 ounces 4 pennyweights 16 grains, for £3 2s. 3d. 3qr.$\frac{3}{5}$; what was it per ounce? *Ans.* 6s. 9d.

37. There is a cistern which has four cocks; the first will empty it in 10 minutes, the second in 20 minutes, the third in 40 minutes, the fourth in 80 minutes; in what time will all four running together empty it?

Ans. 5min. 20sec.

38. A hired two men, B and C, to cut wood for 50cts. per cord; B could cut a cord in 4 hours, C in 6 hours; how long would it take both to cut 1 cord?

Ans. 2 hours, 24 minutes.

39. If, when wheat is 6s. 3d. per bushel, the penny loaf weigh 9 ounces, what ought it to weigh when wheat is 8s. 2½d. per bushel? *Ans.* 6oz. 13drs.+

40. When a man's yearly income is 949 dollars, how much is it per day? *Ans.* $2,60cts.

41. What is the commission on 1525 dollars at 4½dolls. per cent.? Ans. $68,62cts. 5m.

42. What will 374 feet of boards come to at 1½cents per foot? Ans. $5,61cts.

43. What will 39 thousand 6 hundred and 30 casts of staves come to at 15 dollars 50 cents per thousand?

Ans. $614,73cts.

NOTE.—2 staves make 1 cast; 50 casts 1 hundred; 10 hundred 1 thousand; in Maine, by a late law of this State.

44. If the inventory of a town be 358400 dollars, upon which there is assessed a tax of 850 dollars, what will it be on a dollar; and what will B's tax be, whose estate in that town is valued at 1792 dollars?

$\frac{37}{17}$ Ans. { 2mills $\cancel{\frac{37}{100}}$ + on a dollar, and B's tax will be $4,25cts.

45. What will the charter of a ship of 306 tons amount to, from May 28 to October 10th following, at 2 dollars per ton, per month of 30 days?

Ans. 2774 dollars, 40 cents.

NOTE.—The days of receiving and discharging are both included.

46. If $4\frac{1}{2}$ hundred weight may be carried 36 miles for 35s. how many pounds can I have carried 20 miles for the same money, 25lb. a quarter. Ans. 810lb.

47. Sold a ship for £537, and I owned $\frac{3}{8}$ of her, what was my part of the money? Ans. £201 7s. 6d.

48. What quantity of water must I add to a pipe of mountain wine valued at £33, to reduce the first cost to 4s. 6d. per gallon? Ans. $20\frac{2}{3}$ gallons.

49. A and B depart from the same place, and travel the same road; but A goes 6 days before B at the rate of 21 miles a day; B follows at the rate of 28 miles a day; in what time and distance will he overtake *A*?

Ans. { 18 days. 504 miles.

50. A factor bought a certain quantity of broadcloth and drugget, which, together, cost £81: the quantity of broadcloth was 50 yards, at 18s. per yard, and for every 5 yards of broadcloth he had 9 yards of drugget; I demand how many yards of drugget he had, and what it cost him per yard? *Ans.* 90yds. at 8s. per yd.

51. If 60 gallons of water, in one hour fall into a cistern containing 300 gallons, and by a pipe in the cistern, 35 gallons run out in forty minutes: in what time will it be filled? *Ans.* 40 hours.

52. How many yards of cloth 3qrs. wide, will be equal in measure to 30 yards, 5 qrs. wide? *Ans.* 50yds.

53. Bought a pipe of wine for 84 dollars, and found it

leaked out 12 gallons; I sold the remainder at $12\frac{1}{2}$ cents a pint; did I gain or lose, and how much?

Ans. I gained 30 dollars.

54. How many yards of paper, 3 quarters wide, will paper a room, 30 feet long, 24 wide, and 12 high, deducting 31 square feet for the fire-place, door, and windows?

Ans. 180 yards.

55. A garrison consisting of 1500 men, being besieged, have provisions for three months only; but it being necessary that they should hold out five months, how many men must depart, that the same provisions may serve that time?

Ans. 600 men.

56. A regiment of soldiers consisting of 1000 men, are to have new coats, and each coat is to contain 2yds. and 1qr. of cloth that is 5 quarters wide; how much shalloon, that is 3 quarters wide, will line them? Ans. 3750yds.

57. A merchant shipped for the West-Indies 39000 feet of boards, at \$8,20cts. per M.; 300 quintals of fish, at \$2,60cts. per quintal; 15000 shingles, at \$2,20 cents per M.; 34000 hoops, at \$1,60 cents per M.; and \$1000 in cash; and in return, he had [illegible]0 lb. of indigo at 56 cents per lb. 2580 gallons of molasses, at 20 cents per gallon; 1000 pounds of coffee, at 18 cents per lb.; and 18cwt. of sugar, at \$4,50cts. per cwt.; and his charges on the voyage were \$153,80cts. Did he gain or lose by this voyage. Ans. He gained 116 dollars.

PRACTICE.

PRACTICE is a contraction of the Rule of Three, when the first term happens to be a unit, or 1; and is a concise method of ascertaining the value of goods, &c. where money is reckoned in pounds, shillings, and pence; but, since reckoning in Federal Money, in all kinds of business, has become universal in our country, it has here grown into almost total disuse. I shall, therefore, present few examples in this Rule to the attention of the student; and these chiefly in Federal Money. A table of aliquot or even parts of weight he will find annexed to Case 2, in Tare and Tret, page 109.

CASE I.

When the price is an even part of a pound.

RULE.—Find the value of the given quantity, at one pound per yard, &c. and divide it by that even part, and the quotient will be the answer in pounds.

EXAMPLES.

1. What will 129½ yards cost, at 2s. 6d. per yard?

The quantity itself is the price at £1 per yard.

2s. 6d.=⅛ of a £.

	£.	s.	
2s. 6d.(⅛)	129	10	value at £1 per yard.
Ans.	£16	3s. 9d.	value at 2s. 6d. per yard.

2. What will 461 bushels of oats cost at 1s. 8d. per bushel? 1s. 8d.=$\frac{1}{12}$ of a £. Ans. £38 8s. 4d.

3. What will 211¼ bushels of corn cost, at 4s.? 4s.=⅕. Ans. £42 5s.

4. What will 543 bushels of wheat cost, at 6s. 8d.? 6s. 8d.=⅓ Ans. £181.

5. What will 127 gallons of wine cost, at 3s. 4d.? 3s. 4d.=⅙. Ans. £21 3s. 4d.

6. What will 687½ bushels of salt cost, at 5s.? 5s.=¼. Ans. £171 17s. 6d.

CASE II.

When the price is Federal Money, but the quantity of the goods is in several denominations.

RULE.—Multiply the price by the integers in the given quantity, and take parts for the rest from the price of an integer; which added together, will be the answer.

EXAMPLES.

1. What cost 9cwt. 1qr. 8℔. of sugar, at $8,65cts. per cwt.?

		$	cts.
1qr.	¼	8,	65
			9
		77,	85
7℔.	¼	2,	1625
1℔.	⅐	,	5406+
		,	0772+
		$80,	6303+

Ans.=$80,63cts.

2. What cost 7cwt. 3qr. 16℔. of raisins, at $9, 58 cents per cwt. Ans. $75,61cts. 3m.+

3. 12cwt. 0qr. 7℔. of Russian iron, at $6, 34 cents per cwt. at 25℔. a qr.? Ans. $76,52cts. 3m.+

cwt. qr. ℔.

4. 0 0 24 of hemp, at $11,91cts. per cwt.? Ans. $2,55cts. 2m.+

5. 1 0 16 of pig lead, at $6,51cts. per cwt. at 25℔. a qr.? Ans. $7,55cts. $1\frac{3}{5}$m.

6. 0 2 21 of sugar, at $10,24cts. per cwt. at 25℔. a qr.? Ans. $7,27$\frac{1}{25}$cts.

7. 5 cords, 3ft. 8in. of bark, at $4,50cts. per cord? Ans. $24,56$\frac{1}{4}$cts.

8. 3 tons, 5cwt. 2qr. of hay, at $25,10cts. per ton? Ans. $82,20$\frac{1}{4}$cts.

9. 1 ton, 9cwt. 3qr. 17℔. of hay, at $4,44cts. 4m. per ton, at 25℔. a qr.? Ans. $6,64cts. 8m.+

10. 17℔. 5oz. 14dwt. of electuary, at 83 cents per ℔? Ans. $14,50cts.+

11. 32 acres, 1 rood, 14 perches of land, at $1,16cts. per acre? Ans. $37,51cts.+

12. 14 acres, 3 roods, 5 perches of land, at $10,50cts. per acre? Ans. $155,20cts.+

13. 6yds. 3qr. 2na. of cloth, at $7,82cts. 8m.? Ans. $53,81cts. $7\frac{1}{2}$m.

14. 8gal. 3qts. 1pt. 2 gills of wine, at $1, 96 cents? Ans. $17,51$\frac{3}{4}$cts.

The Rule may be applied to other weights and measures also. But perhaps all such questions may be better wrought by multiplication of decimals. Take, for example, the 9th question in this Case:—viz.

What will 1 ton, 9cwt. 3qr. 17℔. of hay come to, at $4,44cts. 4m. per ton, at 25℔. a qr.?

Decimal expression, 1,496 *Ton.* × 4,444 *$* = 6,648224 *$* = 6,648+ *$ c. m.* Answer.

TARE AND TRET.

TARE AND TRET are practical rules for deducting certain allowances, which are made by merchants and tradesmen in selling their goods by weight.

Gross Weight is the whole weight of any sort of goods, together with the box, barrel, or bag, &c. that contains them.

Tare is an allowance made to the buyer for the weight of the box, barrel, or bag, &c. which contains the goods bought, and is either at so much per box, &c., at so much per cwt., or at so much in the gross weight.

Tret is an allowance of 4℔. in every 104℔. for waste dust, &c., or $\frac{1}{26}$ of the whole tare=suttle.

Cloff is an allowance of 2℔. upon every 3cwt. or 336℔.

Suttle is the weight when part of the allowance is deducted from the gross.

Neat weight is what remains after all allowances are made.

CASE I.

When the tare is a certain weight per box, barrel, or bag, &c.

RULE.—Multiply the number of boxes, or barrels, &c. by the tare, and subtract the product from the gross, and the remainder is the neat weight required.

EXAMPLES.

1. In 10 casks of alum, each weighing 3cwt. 2qrs. 12℔. gross, tare 15℔. per cask, how much neat?

	Cwt.	qr.	℔.	
	3	2	12	
			10	
	36	0	8	Gross.
15×10=150℔=	1	1	10	Tare.
	34	2	26	neat, the answer.

2. In 241 barrels of figs, each 3qrs. 19lb. gross, tare 10lb. per barrel, how many pounds neat?

Ans. 22413lb.

3. What is the neat weight of 21 hogsheads of tobacco, each 5cwt. 2qrs. 17lb. gross, tare 100lb. per hogshead, at 25lb. to the qr.? Ans. 98cwt. 7lb.

4. What is the neat weight of 4 chests of hyson tea, weighing, gross 96lb. 97lb. 101lb. and 103lb., tare 20lb. per chest? Ans. 317lb.

CASE II.

When the tare is a certain weight per cwt.

RULE.—Divide the gross weight by the aliquot* parts of an cwt. contained in the tare, and subtract the quotient from the gross, and the remainder is the neat weight.

EXAMPLES.

1. Gross 372cwt. 3qrs. 17lb., tare 16lb. per cwt., how much neat?

	Cwt.	qrs.	lb.	
16lb. is $\frac{1}{7}$)	372	3	17	
	53	1	$2\frac{3}{7}$	tare subtracted.
	319	2	$14\frac{4}{7}$	the answer.

2. What is the neat weight of 7 barrels of potash, each weighing 402lb. gross, tare 10lb. per cwt., at 25lb. to the qr.? Ans. 2532lb. $9\frac{3}{5}$oz.

* An aliquot part of any number is such a part of it as, being taken a certain number of times, exactly makes that number.—If 100lb. be taken for a cwt., 50lb.$=\frac{1}{2}$; 25lb.$=\frac{1}{4}$.

TABLE OF ALIQUOT PARTS.

Parts of an cwt.		Parts of $\frac{1}{2}$ cwt.		Parts of $\frac{1}{4}$ cwt.	
2 qrs. is	$\frac{1}{2}$	28lb. is	$\frac{1}{2}$	14lb. is	$\frac{1}{2}$
1 - -	$\frac{1}{4}$	14 - -	$\frac{1}{4}$	7 - -	$\frac{1}{4}$
16lb. is -	$\frac{1}{7}$	8 -	$\frac{1}{7}$	4 - -	$\frac{1}{7}$
14 - -	$\frac{1}{8}$	7 - -	$\frac{1}{8}$	$3\frac{1}{2}$ - -	$\frac{1}{8}$
8 -	$\frac{1}{14}$	Of 50lb. 25	$\frac{1}{2}$	Of 25lb. $12\frac{1}{2}$	$\frac{1}{2}$
7 - -	$\frac{1}{16}$	$12\frac{1}{2}$	$\frac{1}{4}$	$6\frac{1}{4}$	$\frac{1}{4}$
Of 100lb. $12\frac{1}{2}$	$\frac{1}{8}$	10	$\frac{1}{5}$	5	$\frac{1}{5}$
10	$\frac{1}{10}$	5	$\frac{1}{10}$	$3\frac{1}{8}$	$\frac{1}{8}$
5	$\frac{1}{20}$				

3. In 129cwt. 3qrs. 16lb. gross, tare 14lb. per cwt., what is the neat weight? Ans. 113cwt. 2qrs. 17½lb.

4. In 25 barrels of figs, each 2cwt. 1qr. gross, tare 16lb. per cwt., how much neat? Ans. 48cwt. 0qrs. 24lb.

CASE III.

When tret is to be allowed with tare.

Rule.—Divide the suttle weight by 26, and the quotient is the tret, which subtract from the suttle, and the remainder is the neat weight.

EXAMPLES.

1. In 9cwt. 2qrs. 17lb. gross, tare 37lb. and tret as usual, how much neat?

	Cwt.	*qrs.*	*lb.*	
	9	2	17	gross.
		1	9	tare.
26)	9	1	8	tare-suttle.
		1	$12\frac{2}{13}$	tret.
	8	3	$23\frac{11}{13}$	Ans.

2. In 7 casks of prunes, each weighing 4cwt. gross, tare 17½lb. per cwt. and tret as usual, how much neat, at 25lb. to the qr.? Ans. 22cwt. $21\frac{7}{13}$lb.

3. What is the neat weight of 3hhds. of sugar weighing as follows; the first 4cwt. 5lb. gross, tare 73lb.; the second 3cwt. 3qrs. gross, tare 56lb.; and the third 2cwt. 3qrs. 17lb. gross, tare 47lb.; and allowing tret to each as usual, 25lb. a qr.? Ans. 8cwt. 1qr. 12½lb.

4. What is the neat weight of 10 casks of raisins, each weighing 3cwt. 2qrs., tare 14lb. per cwt., tret as usual? and what will be the amount at $15 per cwt.?

Ans. 29cwt. 1qr. $22\frac{1}{13}$lb. $441,70cts. 6m.+

CASE IV.

When tare, tret, and cloff, are all allowed.

Rule.—Deduct the tare and tret, as before, and divide the suttle by 168, and the quotient is the cloff, which subtract from the suttle, and the remainder is the neat.

EXAMPLES.

1. What is the neat weight of a hhd. of tobacco, weighing 15cwt. 3qrs. 20lb. gross, tare 7lb. per cwt., tret and cloff as usual?

	Cwt.	qrs.	lb.	oz.	
7lb. is $\frac{1}{16}$)	15	3	20	0	gross.
		3	27	8	tare.
26)	14	3	20	8	tare-suttle.
		2	8	5+	tret.
168)	14	1	12	3	tret-suttle.
			9	9+	cloff.
	14	1	2	10	Answer, nearly.

NOTE.—Some say 2lb. for every 100lb. of tret-suttle ought to be allowed, to make the weight hold good when sold by retail; instead of 2lb. on every 336lb.

2. What is the value, at $5\frac{3}{4}$d. per lb., neat weight, of 26 chests of sugar, each 9cwt. 2qrs. $15\frac{1}{2}\frac{5}{8}$lb. gross, tare 13lb. per cwt., tret as usual, and cloff 2lb. on 300lb.; 25lb. a qr.? *Ans.* £499 15s. 5d.

DOUBLE RULE OF THREE.

THE DOUBLE RULE OF THREE teaches to solve such questions as require two or more statings in the Rule of Three. In these questions there is always given an odd number of terms as five, seven, or nine, &c. These are distinguished into *terms of supposition*, and *terms of demand*, the number of the former always exceeding that of the latter by one, which is of the same kind with the term or answer sought.

RULE.—Write the term of supposition, which is of the same kind with the answer, for the middle term.

Take one of the other terms of supposition, and one of the demanding terms of the same kind with it; then place one of them for a first term, and the other for a third, according to the directions given in the Rule of Three. Do the same with another term of supposition, and its corresponding demanding term; and so on, if

there be more terms of each kind, writing the terms under each other, which fall on the same side of the middle term.

Multiply together all the terms in the first place, and also all the terms in the third place. Then multiply the latter product by the middle term, and divide the result by the former product; and the quotient will be the answer required. Or, take the two upper terms and the middle term, in the same order as they stand, for the first stating of a question in the *Single* Rule of Three; then take the fourth number resulting from the first stating, for the middle term of a new stating in the abov[illegible]le, and the two under terms of the Double R[illegible] stating, in the same order as they stand [illegible] terms of the new stating; and the fo[illegible]g from this new stating, will be the an[illegible]

NOTE 1.—The first and third te[illegible]f different denominations, must be red[illegible]e-nomination.

2. After stating, and before comme[illegible], if one of the first terms, and either t[illegible]dle [illegible] or one of the last terms will exactly divide [illegible] one and the same number, let them be divided, and the quotients used, instead of them; which will much shorten the work. Make trial with the first Example.

EXAMPLES.

1. How many men can complete a trench of 135 yards long in eight days, provided 16 men can dig 54 yards in 6 days?

$$\left.\begin{matrix} 54 \text{ yards} \\ 8 \text{ days} \end{matrix}\right\} : 16 \text{ men} :: \left\{\begin{matrix} 135 \text{ yards} \\ 6 \text{ days} \end{matrix}\right\} :$$

432 810
16
4860
810
432)12960(30 men, Ans.
1296
0

Here $54 \div 27 = 2$. $135 \div 27 = 5$.
$8 \div 2 = 4$. And $6 \div 2 = 3$.
Then $2 \times 4 = 8$, and $16 \div 8 = 2$
And $5 \times 3 = 15$, and $15 \times 2 = 30$.
Therefore, the answer by Note 2, is 30 men.

2. If £100 in one year gain £6 interest, what will be the interest of £750 for 7 years?

$$\left.\begin{matrix}1 \text{ year} \\ £100\end{matrix}\right\} : £6 : : \left\{\begin{matrix}7 \text{ years} \\ £750\end{matrix}\right\} : £315 \text{ Ans.}$$

3. A farmer sells 204 dollars' worth of grain in 5 years, when it sold at 60 cents per bushel; what is it per bushel when he sells 1000 dollars' worth in 18 years, if he sell the same quantity yearly? Ans. 81cts. 6$\frac{9}{10}$ mills.+

4. If 7 men can reap 84 acres of wheat in 24 days, how many men can reap 100 acres in 10 days? Ans. 20 men.

5. If 6 men build a wall 20 feet long, 6 feet high and 4 feet thick, in 16 days; in what time will 24 men build one 200 feet long, 8 feet high and 6 feet thick? Ans. 80 days.

$$\left.\begin{matrix}24 \text{ men} \\ 20 \text{ feet long} \\ 6 \text{ feet high} \\ 4 \text{ feet thick}\end{matrix}\right\} : 16 \text{ days} : : \left\{\begin{matrix}6 \text{ men} \\ 200 \text{ feet long} \\ 8 \text{ feet high} \\ 6 \text{ feet thick}\end{matrix}\right\} : 80 \text{ days.}$$

6. An usurer put out 75 dollars at interest, and at the end of 8 months he received for principal and interest, 79 dollars; I demand at what rate per cent. he received interest. Ans. 8 per cent.

7. If the carriage of 13cwt. 1qr. for 72 miles be £2 10s. 6d. what will be the carriage of 7cwt. 3qrs. for 112 miles? Ans. £2 5s. 11d. 1$\frac{77}{159}$qr.

8. If a family of 9 persons spend 450 dollars in 5 months, how much would be sufficient to maintain them 8 months, if 5 more were added to the family? Ans. 1120 dollars.

9. What is the interest of 654 dollars for 164 days, at 6 per cent. per annum? Ans. 17dolls. 63cts. 1m.+

10. If 248 men in 5 days of 11 hours each, dig a trench 230 yards long, 3 yards wide and 2 deep; in how many days of 9 hours long, will 24 men dig a trench 420 yards long, 5 wide and 3 deep? Ans. 288$\frac{59}{207}$ days.

11. If 30 men perform a piece of work in 20 days, how many men will effect another piece of work, 4 times as large, in a fifth part of the time? Ans. 600 men.

12. What principal will gain \$315 in 7 years, at 6 per cent. per annum? Ans. \$750.

13. If 3000lb. of beef will serve 340 seamen 15 days, how many pounds will serve 120 seamen 25 days? Ans. 1764lb. 11$\frac{15}{51}$oz.

CONJOINED PROPORTION.

Conjoined Proportion is when the coins, weights, or measures of several countries, are compared in the same question; or it is the joining together of several ratios, and inferring the ratio of the first antecedent and last consequent, from the ratios of the several antecedents and their respective consequents.

CASE I.

When it is required to find how many of the last kind of coin, weight, or measure, mentioned in the question, are equal to a given number of the first.

Rule 1.—Multiply continually together the antecedents for the first term, and the consequents for the second, and make the given number the third.

2. Then find the fourth term or proportional, which will be the answer required.

EXAMPLES.

1. If 10lb. at Boston make 9lb. at Amsterdam; 90lb. at Amsterdam 112lb. at Thoulouse; how many lb. at Thoulouse are equal to 50lb. at Boston?

Ant.		*Con.*	
10	:	9	
90	:	112	
900	:	1008	: : 50 : 56lb. Ans.

2. If 20 brasses at Leghorn be equal to 10 varas at Lisbon; 61 varas at Lisbon to 75 American yards; how many American yards are equal to 100 brasses at Leghorn?

Ans. $61\frac{29}{61}$ yards.

CASE II.

When it is required to find how many of the first kind of coin, weight, or measure, mentioned in the question, are equal to a given number of the last.

Rule.—Proceed as in the first case, only make the product of the consequents the first term, and that of the antecedents the second.

EXAMPLES.

1. If 20 ells English make 11 canes at Rome; 44 canes at Rome, 136 brasses at Venice; how many ells English make 85 brasses at Venice?

Ant.		Con.	
20	:	11	
44	:	136	
880		1496	: 880 : : 85 : 50ells. Ans.

2. If 41 U. S. bushels make 26 hanegas at Cadiz; 39 hanegas at Cadiz, 162 alquiers at Lisbon; 27 alquiers at Lisbon, 5 sacks at Leghorn; and 20 sacks at Leghorn, 21 tons at Copenhagen; how many U. S. bushels make 36 tons at Copenhagen? Ans. $70\frac{2}{7}$bus.

3. If 300 U. S. miles make 77 miles in Germany; 1771 miles in Germany, 1250 posts in France; and 25 posts in France, 38 miles in Holland; how many U. S. miles make 80 in Holland? Ans. $290\frac{10}{19}$ U. S. miles.

BARTER.

Barter is the exchanging of one commodity for another, and directs traders so to proportion their goods, that neither party may sustain loss.

Rule.*—Find the value of that commodity the quantity of which is given; then find what quantity of the other, at the rate proposed, you may have for the same money, and it gives the answer required.

EXAMPLES.

1. How many dozen of candles, at 3s. 6d. per dozen, must be given in barter for 4cwt. 2qrs. of tallow, at 46s. per cwt.?

* This rule is only an application of the Rule of Three.

qrs.		s.		cwt. qrs.
4	:	46	::	4 2
		18		4
		368		18
		46		
		4)828		
		2,0)20,7		
		£10 7s.		

s. d.		doz.		£ s.		
3 6	:	1	::	10 7	:	59doz. 1+Ans.

2. A buys of B 4 hogsheads of rum containing 410 gallons, at 1 dollar 17 cents per gallon; and 253℔. of coffee at 21 cents per ℔.: In part of which he pays him 21 dollars in cash, and the balance in boards at 8 dollars per thousand; how many feet of boards does the balance require? Ans. 63978$\frac{3}{4}$feet.

3. Bought a sloop of 70 tons at 16 dollars per ton; paid in cash 500 dollars, 350 gallons of molasses at 64cts. per gallon, and the balance in New-England rum at 74cts. per gallon; how many gallons did it amount to?

Ans. 535$\frac{5}{37}$gal.

4. A barters with B 150 bushels of wheat at 5s. 9d. per bushel, for 65 bushels of corn at 2s. 10d. per bushel, and the balance in oats at 2s. 1d. per bushel; what quantity of oats must A receive? Ans. 325$\frac{3}{5}$ bushels.

5. How much wine at 1 dollar 28 cents per gallon, must I receive in barter for 26cwt. 2qrs. 14℔. of raisins at 9 dollars 44 cents 4 mills per cwt., 25lb. a qr.?

Ans. 196gals. 2qts. 1,704gills.

6. A delivers B 3 hogsheads of brandy at 6s. 8d. per gallon, for 126 yards of cloth; what was the cloth per yard in Federal Money? Ans. 1 dollar 66$\frac{2}{3}$cts.

7. A has a quantity of pepper, weight neat 1600lb. at 1s. 5d. per lb. which he barters [illegible] B [illegible] two sorts of goods, the one at 5d. the other at 8d. per pound, and to have $\frac{1}{3}$ in money, and of each sort of goods an equal quantity; how many lb. of each must he receive, and how much in money?

Ans. 1394$\frac{34}{39}$lb. of each, and £37 15s. 6$\frac{2}{3}$d.

8. A and B barter; A has 145 gallons of brandy, at $1, 20 cents per gallon ready money, but in barter he will have $1, 35 cents per gallon; B has linen at 58 cents per yard ready money; how must B sell his linen per yard, in proportion to A's barter price, and how many yards are equal to A's brandy?

Ans. { B's linen is 65 cents, $2\frac{1}{2}$ mills, barter price, and he must give A 300yds. for his brandy.

9. K and L barter; K has woollen cloth worth $1,33 cents, per yard, which he barters at $1, 54 cents, with L, for linen cloth, at 50 cents per yard, which is worth 43 cents per yard;—who has the advantage in barter, and how much linen does L give K for 70 yards of woollen?

Ans. { $215\frac{3}{5}$yds. of linen, and L has the advantage, his proportional barter price being only $49\frac{15}{19}$cts.

10. J. Tucker and Jonathan Olmstead barter; the former gives the latter 90 gallons of brandy at $1, 28 cents per gallon; for which the latter gives the former 10 guineas at 28s. each, in money, and 500℔. of cotton;—what is it valued at per pound? Ans. 1[illegible]$\frac{52}{75}$cts.

11. Giles Jackson has 100 reams of paper, at $1, $33\frac{1}{3}$ cents ready money, which in barter he sets down at $1,$66\frac{2}{3}$ cents; Robert Howard, sensible of this, has pamphlets at $8\frac{1}{3}$ cents apiece ready money, which he adequately charges, and insists, besides, on $\frac{1}{4}$ of the price of those he parts with, in money;—what number of the books is he to deliver in lieu of Jackson's paper? what cash will make good the difference? and how much is Howard the gainer by this affair? Ans. 1600 books to be delivered; $41,$66\frac{2}{3}$cts. Howard is to have in cash; and the gain to Howard is $41,$66\frac{2}{3}$cts.

LOSS AND GAIN.

Loss and Gain is a rule that discovers what is gained or lost in buying or selling goods; and instructs merchants and traders to raise or lower the price of their goods, so as to gain or lose a certain sum per cent.

Questions in this rule are performed by the Rule of Three.

There is, indeed, great variety in questions in this rule; but they may be all easily solved by a little consideration, and the following proportion, viz.—That the *gains* or *losses* are in proportion to the *quantities* of goods.

EXAMPLES.

1. Bought 30 hogsheads of molasses, for 600 dollars; paid in duties 20 dollars, 66 cents, for freight 40 dollars, 78 cents, for storage 6 dollars, 5 cents, and for insurance 30 dollars, 84 cents;—If I sell it at 26 dollars per hogshead, how much shall I gain per cent.?

$	*cts.*		$		
600			26		
20	66			30 hhds.	
40	78				
6	05		$780	00	Sold for.
30	84		698	33	Cost.
698	33		81	67	Gain.

$ *cts.* $698\ 33 : 81\ 67 :: 100 : 11\ 69+$ Ans.

2. At 3s. 6d. profit on the pound, how much per cent.?
Ans. £17 10s.

3. If 1 ℔. of coffee cost 28 cents and it sold for 31 cents, what is the profit on 293*lb.* neat? Ans. 8dols. 79cts.

4. If a gallon of wine cost 6s. 8d. and is sold for 7s. 2d. what is the gain per cent.? Ans. $7\frac{1}{2}$ per cent.

5. Sold a repeating watch for 175 dollars, upon which I lost 17 per cent. whereas I ought to have gained 20 per cent.; how much was it sold for under its just value?
Ans. 78 dollars, 1 cent.+

6. If I buy broadcloth for 13s. 5d. per yard, how must I sell it to gain at the rate of 25 per cent.?

£ 100 : £. 125 :: *s. d.* 13 5 : *s. d.* 16 $9\frac{1}{4}$ Ans.

Or thus, 4)13 5
3 $4\frac{1}{4}$

16s. $9\frac{1}{4}$d.

7. Bought rum for 90 cents per gallon; at what rate must it be sold to gain 20 per cent.? Ans. 108cts.

8. Bought 115 gallons of rum at 1 dollar, 10 cents per gallon; how many gallons of water must be put in, so as to gain 5 dollars by selling it at 1 dollar per gallon?

Ans. 16½ gallons.

9. Bought a hogshead of molasses, containing 119 gallons, at 52 cents per gallon; paid for carting the same $1, 25 cents; and by an accident 9 gallons leaked out;—at what rate per gallon must I sell the remainder, so as to gain $13 in the whole? Ans. 69cts. 2m.+

10. Bought 11cwt. of sugar, at 6½d. per lb. but could not sell it again for any more than £2 16s. per cwt.; did I gain or lose by my bargain? Ans. Lost £2 11s. 4d.

11. Bought cloth at 17s. 6d. per yard, which on examination, I find to be much damaged; and am, therefore, content to lose 15 per cent. by it;—how must I sell it per yard? Ans. 14s. 10½d.

12. By selling broadcloth at $3, 25 cents per yard, I lose at the rate of 20 per cent.; what is the prime cost of said cloth per yard? $4 6cts. 2½m.

13. If, when I sell cloth at $7 per yard, I gain $10 per cent.; what will be the gain per cent. when it is sold for 8 dollars per yard? Ans. $25, 71cts. 4m.+

14. If I sell a cwt. of sugar for 8 dollars, and thereby lose 12 per cent.; what shall I gain or lose per cent., if I sell 4cwt. of the same sugar for 36 dollars?

Ans. I lose only 1 per cent.

FELLOWSHIP.

Fellowship is a rule by which merchants, &c. trading in company with a joint stock, determine each person's particular share of the gain or loss in proportion to his share in the joint stock.

By this rule a bankrupt's estate may be divided among his creditors; as also legacies adjusted when there is a deficiency of assets or effects.

SINGLE FELLOWSHIP.

Single Fellowship is when different stocks are employed for any certain equal time.

Rule.*—As the whole stock is to the whole gain or loss, so is each man's particular stock to his particular share of the gain or loss.†

Proof.—Add all the shares together, and the sum will be equal to the gain or loss, when the work is right.

EXAMPLES.

1. *A* and *B* gained by trade £182. *A* put into stock £300 and *B* £400; what is each person's share of the profit?

£.	£.	£.	£.	£.
300+400=700	: 182	: : 300	: 78	*A*'s share.
700	: 182	: : 400	: 104	*B*'s share.
			£182	Proof.

2. *A* man dying, bequeathed his estate to his three sons in the following manner, viz. to the eldest he gave $1840, to the second $1550, and to the third $960; but it was found his whole estate was no more than $1840; what is each one's proportion?

Ans. $\begin{cases} \$778,29\frac{77}{87} \text{ the first.} \\ 655,63\frac{19}{87} \text{ the second.} \\ 406,06\frac{78}{87} \text{ the third.} \end{cases}$

3. A and B companied; A put in 450 dollars, and received $\frac{3}{5}$ of the gain; what did B put in? *Ans.* $300.

4. Three merchants freight a ship with wine; A loaded 110 tuns, B 97 tuns, and C 133 tuns. In a storm the seamen were obliged to throw 85 tuns overboard; how much must each sustain of the loss?

Ans. A $27\frac{1}{2}$, B $24\frac{1}{4}$, C $33\frac{1}{4}$ tuns.

5. Three men, A, B, and C, contract to build the hull of a vessel for 625 dollars; A works 160 days, and his work is estimated at 1 dollar 80 cents per day; B works $101\frac{1}{4}$ days, estimated at 1 dollar 60 cents per day; and C

* That the gain or loss in this rule is evidently in proportion to their stocks, may be shown from the nature of the Rule of Three.

† The first and third contractions of note 4 of the Rule of Three, are often the best for working questions in this rule, especially in decimals.

works 98 days, at 1 dollar 50 cents per day: how much is each man's proportion according to his work?

day.	*\$. cts.*	*days.*	*day.*	*\$. cts.*	*days.*	*day.*	*\$. cts.*	*days.*
1 :	1 80 : :	100	1 :	1 60 : :	$101\frac{1}{4}$	1 :	1 50 : :	98
	100			1 $01\frac{1}{4}$				150
	180,00 A's work.			40				4900
	162,00 B's do.			160				98
	147,00 C's do.			160				147,00
	489			162,00				

\$.	*\$.*		*\$.*		*\$. cts.*
489 :	625	: :	162	:	$207,05\frac{85}{163}$
489 :	625	: :	147	:	$187,88\frac{56}{163}$
489 :	625	: :	180	:	$230,06\frac{22}{163}$

Ans. $\left\{\begin{array}{l} \$230,06\frac{22}{163} \text{ A's share.} \\ 207,05\frac{85}{163} \text{ B's do.} \\ 187,88\frac{56}{163} \text{ C's do.} \end{array}\right.$

\$625,00 Proof.

6. A ship worth 3600 dollars being entirely lost, of which $\frac{1}{8}$ belonged to A, $\frac{1}{4}$ to B, and the rest to C; what loss will each sustain? Ans. A \$450. B \$900. C \$2250.

7. A and B gained 1260 dollars of which A is to have ten per cent. more than B: what is the share of each?
Ans. A 660dolls. B 600dolls.

8. Three merchants made a joint stock—A put in £565 6s. 8d. B £478 5s. 4d. and C a certain sum; they gained £373 9s. 11d. of which C took £112 11s. 11d. for his part; what is A and B's part of the gain, and how much did C put in?

Ans. $\left\{\begin{array}{ll} \text{A's gain} & £141\ 6s.\ 8d. \\ \text{B's do.} & 119\ 11s.\ 4d. \\ \text{C put in} & 150\ 7s.\ 8d. \end{array}\right.$

9. A, B, and C, traded in company; A put in \$140; B, \$250; and C put in 120yds. of cloth, at cash price; they gained \$230, of which C took \$100 for his share of the gain;—how did C value his cloth per yard in common stock, and what was A's and B's part of the gain?

Ans. { C put in his cloth at $\$2\frac{1}{2}$ per yard; B's part of the gain was $\$83,33\frac{1}{3}$cts.; and A's $\$46,66\frac{2}{3}$cts.

DOUBLE FELLOWSHIP.

DOUBLE FELLOWSHIP is when the stocks are employed for different times.

RULE.*—Multiply each man's stock by the time of its continuance: then say, as the sum of all the products is to the whole gain or loss, so is each man's particular product to his particular share of the gain or loss.

EXAMPLES.

1. A and B hold a piece of ground in common, for which they pay £36—A put in 23 oxen for 54 days, B 21 oxen for 70 days; what part of the rent must each man pay?

$23 \times 54 = 1242$
$21 \times 70 = 1470$

$$2712 : \overset{\pounds}{36} :: \begin{cases} 1242 \\ 1470 \end{cases} : \begin{array}{llll} \pounds. & s. & d. & \\ 16 & 9 & 8\tfrac{92}{113} & \text{A's.} \\ 19 & 10 & 3\tfrac{21}{113} & \text{B's.} \end{array}$$

£36 Proof.

2. Two merchants enter into partnership for 16 months. A put in at first 1200 dollars, and at the end of 9 months 200 dollars more; B put in at first 1500 dollars, and at the expiration of 6 months took out 500 dollars—with this stock they gained 772 dollars, 20 cents; what is each man's part of it?

Ans. A's $401 70 cents—B's $370 50 cents.

3. A, B and C, enter into partnership; A put in 85 dollars for 8 months, B put in 60 dollars for 10 months, and C 120 dollars for 3 months; by misfortune they lost 41 dollars; what part of the loss must each man sustain?

Ans. A's part $17. B's $15. C's $9.

4. W. Thomas and N. White were joint tenants of a mill, in the building of which Thomas laid out $150, and White $270. At the end of 7 months, Thomas sold his share to White; and at the end of the first year White sold the mill. They then made a settlement; and, the year's profit of the mill being ascertained at $260, what was each man's share?

Ans. Thomas's $54,16⅔cts. White's $205,83⅓cts.

* When the times are equal, the shares of the gain or loss are evidently as the stocks, as in Single Fellowship; and when the stocks are equal the shares are as the times; but when neither are equal, the shares must be as their products.

5. Jacob M'Ewen, Giles Jackson, John Hastings, and Anthony Minot, were joint tenants of a certain toll bridge, which they held for the term of 14 years, by charter. Their whole expense in building the bridge, was $25745, 50cts., of which M'Ewen paid $4896,67cts., Jackson $1675, Hastings $12392,87cts., and Minot $6780,96cts. At the end of $2\frac{1}{2}$ years, M'Ewen sold out to Peter Thomson; at the end of 5 years, Jackson sold out to Jeremiah Apthorp; and at the end of 10 years, Hastings sold his share to James Hawkins; at the expiration of the 14 years, the whole tollage amounted to $30,000. What was each man's share?

Answer.	M'Ewen's,	$1018,90c. 2m.+
	Jackson's,	697,07c.+
	Hasting's,	10314,87c.+
	Minot's,	7901,52c. 8m.+
	Thomson's,	4686,95c. 2m.+
	Apthorp's,	1254,72c. 6m.+
	Hawkins',	4125,94c. 8m.+

SIMPLE INTEREST.

Interest is the sum paid by the borrower to the lender for the use of money lent.

The legal interest in most of the United States is 6 per cent. per annum; that is, £6 for the use of £100, or $6 for the use of $100 for one year, &c.

Principal is the money for which the compensation is made.

Rate is the sum per cent. agreed on.

Amount is the principal and interest added together.

Interest is of two kinds; *simple* and *compound*. *Simple* Interest is that which is allowed for the sum lent only.

Rule.*—Multiply the principal by the rate, and divide the product by 100; and the quotient is the interest for one year. Multiply the interest for one year by the given number of years, and the product is the interest for that time. For any parts of a year, as months, days, &c. di-

* Simple Interest is only an application of the Rule of Three.

vide the interest for one year by the aliquot parts of a year or month; or the interest may be found by a statement in the Rule of Three.*

NOTE.—In Federal Money the quotient after the division by 100 gives the answer in the same name with the lowest denomination in the principal.

TABLE OF ALIQUOT PARTS.

Parts of a year.		*Parts of a Month.*	
6 Months is	$\frac{1}{2}$	3 days is	$\frac{1}{10}$
4	$\frac{1}{3}$	5	$\frac{1}{6}$
3	$\frac{1}{4}$	6	$\frac{1}{5}$
2	$\frac{1}{6}$	10	$\frac{1}{3}$
$1\frac{1}{2}$	$\frac{1}{8}$	15	$\frac{1}{2}$
1	$\frac{1}{12}$		

EXAMPLES.

1. What is the interest of £639 for one year, at 6 per cent.? *Ans.* £38 6s. $9\frac{1}{2}$d.+

```
     639
       6
   -----
  £38,34
      20
   -----
  s. 6,80
      12
   -----
  d. 9,60
       4
   -----
  qr. 2,40
```

* Calling 30 days a month gives the interest too much. If the principal be small, the errour is trifling. But, if the sum be very large, say—as, 365 days: is to the interest for 1 year; so is the given number of days; to the interest required.

2. What is the interest of 372 dollars for one year, 5 months, and 5 days, at 6½ per cent.?

```
                    372
                     6½
                   ----
                   2232
                    186
                   ----
4 months, ⅓       $24,18 Interest for one year.
1 month, 1/12       8,06 Interest for four months.
5 days, ⅙ of 1 mo.2,01½ Interest for one month.
                    33½+ do. five days.
                   ----
                  $34,59+ Answer.
```

3. What is the amount of £49 6s. 4½d. for one year, at 6 per cent.?

```
     £.   s.  d.
     49   6   4½
              6
    -------------
    2,95  18  3
      20
    -----             s.  d.
    19,18        £49  6   4½ Principal.
       12          2  19  2  Interest.
    -----        ----------
     2,19  Ans.  £52  5   6½ Amount.
```

4. What is the interest of 1600 dollars for one year and three months, at 6 per cent.? Ans. $120.

5. What is the interest of £71 7s. 6½d. for 2 years, at 6 per cent.? Ans. £8 11s. 3½d.+

6. What is the interest of 67 dollars, 62 cents, for 3 years and 2 months, at 6 per cent.? Ans. $12,84cts. 7mills.+

7. How much is the interest of 325 dollars for 3 years, at 6 per cent.? Ans. $58,50cts.

8. How much is the interest of 66 cents, 4 mills, for one year and 7 months, at 6 per cent.? Ans. 6cts. 3mills.+

9. What is the interest of 48 dollars, 25 cents, 5 mills, for 5 years, at 5 per cent.? Ans. $12,6cts. 3mills.

10. What is the interest of 48 dollars for 3 years, at 9 per cent.? Ans. $12,96cts.

11. What is the interest of £5 16s. 3d. for one year and 6 months, at 6 per cent.? Ans. 10s. 5½d.+

12. What is the interest of 9672 dollars, from Nov. 30, 1823, to July 4, 1826, at 8 per cent.?
Ans. $2007,47cts. 7m.+

To find the interest of any sum at 6 per cent. per annum, for any number of months.

Rule.*—Multiply the principal by half the number of months, and that product divided by 100 will be the interest for the given time.

EXAMPLES.

1. What is the interest of 64 dollars, 50 cents, for 8 months, at 6 per cent.?

$$\begin{array}{lr} & 64,50 \\ 8 \div 2 = 4 & 4 \\ \hline & 1,00)2,58,00 \\ \hline \end{array}$$

Ans. 2dolls. 58cents.

2. How much is the interest of 36 dollars, 84 cents, for 5 months, at 6 per cent.? Ans. 92cts. 1mill.

3. How much is the interest of 750 dollars for 15 months, at 6 per cent.? Ans. $56,25cts.

4. What is the interest of £24 15s. 4½d. for 10 months, at 6 per cent.? Ans. £1 4s. 9d. $\frac{9}{10}$qr.

5. What is the interest of 468 dollars for one month, at 6 per cent.? Ans. $2,34cts.

To find the interest of any sum for any number of days when the rate is 6 per cent.

Rule.—Multiply the principal by the number of days, and divide the product by 6083; the quotient will be the interest required.

* The reason of the rule.—When the time is months, multiplying by the rate for the time gives the answer.
This rate is found by multiplying the time by the given rate per cent for a year, and dividing the product by 12; the quotient is the rate required, and is always equal to half the months, when the yearly rate is 6 per cent.

EXAMPLES.

1. What is the interest of 376 dollars, 20 cents, for 80 days, at 6 per cent.?

```
                376,20
                    80
          ———————— $ cts. m.
6083)30096,00(4,94 7+ Answer.
```

2. What is the interest of £749 10s. 6d. for 12 days, at 6 per cent.?

```
        £.  s.  d.
       749 10   6
               12
      ————————————
6083)8994 6 0(£1 9s. 6¾d.+ Answer.
```

SHORT PRACTICAL RULES

For calculating Interest at 6 per cent. either for months, or months and days.

I. FOR POUNDS, SHILLINGS, &c.

RULE.—If the principal consist of pounds only, cut off the unit figure, and as it then stands, it will be the interest, for one month, in shillings and decimal parts. Multiply this sum by the given number of months, and take parts for the days, and you will have the answer in shillings and decimal parts, which you may reduce. But if the principal consist of pounds, shillings, &c. reduce it to its decimal value; then remove the decimal point one place or figure, further towards the left hand, and as the number then stands, it will show the interest for one month, in shillings and decimals of a shilling. Multiply by the given time, &c. and you will have the answer.

EXAMPLES.

1. Required the interest of £48 for 5 months and 10 days, at 6 per cent.

```
   Days. s.
   10|⅓|4,8 interest for 1 month.
          5
       ————
       24,0  do.  for 5 months.
        1,6  do.  for 10 days.
       ————
  Ans. 25,6 shillings=£1 5s. 7⅕d.
         12
       ————
        7,2
```

2. Required the interest of £56 10s. for 11 months, at 6 per cent.

£. s. £.
56 10=56,5 decimal value.
Therefore 5,65 shillings interest for one month.
11

Ans. 62,15 interest for 11 months=£3 2s. 1,8d.

3. What is the interest of £87 7s. 6d. for one year, 7 months, and a half, at 6 per cent. per annum?
Ans. £8 10s. 4d. 2,3qrs.

4. Required the interest of £28 16s. for 20 days, or two-thirds ef a month, at 6 per cent. *Ans.* 1s. 11,04d.

NOTE.—The foregoing rule will serve also, when the rate is 5 per cent. or 7 per cent. For, when, by the Rule, you have found the interest of any sum, at 6 per cent., if you decrease the said interest by one-sixth of itself, it then becomes the interest of the same sum, at 5 per cent.; or if, after finding the interest, by the Rule, at 6 per cent., you increase the said interest by one-sixth of itself, it then becomes the interest of the same sum, at 7 per cent.

Take for examples the first two of the preceding ones.

Required the interest of £48 for 5 months and 10 days, at 5 per cent.

s
$\frac{1}{6}$)25,6 interest at 6 per cent.
4,26

Ans. 21,33s. int. at 5 per cent.=£1 1s. 4d.

What is the interest of £56 10s. for 11 months, at 7 per cent.?

s.
$\frac{1}{6}$)62,15 int. at 6 per cent.
10,3583

Ans. 72,5083 shill. int. at 7 per cent.=£3 12s.6,1d.

II. *For Federal Money.*

RULE.—Divide the Principal by 2, placing the separatrix as usual, and the quotient will be the interest for one month, in cents, and decimals of a cent; that is, the

figures at the left of the separatrix will be cents and those on the right, decimals of a cent. Then multiply this sum by the given number of months, or months and decimal parts thereof, or for the days take even parts of 30, &c.

EXAMPLES.

1. Required the interest of $562,64cts. for $5\frac{1}{2}$ months, at 6 per cent.

2)562,64

281,32 interest for 1 month.
$5\frac{1}{2}$

140,66 interest for $\frac{1}{2}$ month.
1406,60 interest for 5 months.

Ans. 1547,26=$1547\frac{26}{100}$cts,=$15,47cts. 2,6m.

Or thus, 281,32 interest for 1 month.
×5,5 months.

1406 60
14066 0

1547,260cts.=$15,47cts. 2,6m.

2. What is the interest of $18, 48 cents, for 3 years, 7 months, and 10 days, at 6 per cent.?

2)18,48

10 days=$\frac{1}{3}$ 9,24 interest for 1 month.
43 months.

2772
3696

397,32 interest for 43 months.
3,08 interest for 10 days.

*A*ns. 400,4,0 cents=$4 and 4 mills.

3. What is the interest of $468 for 7 months, at 6 per cent.? Ans. $16,38cts.

For 5 or 7 per cent. proceed according to the directions in the preceding Note.

To compute Interest on Notes, Bonds, &c. having partial Payments or endorsements thereon.

RULE 1.—Cast the interest upon the whole principal, for the whole time; then separately upon each endorsement, for its respective time; and subtract the whole amount of the one from that of the other.

NOTE.—I call 30 days a month, and 12 months a year.

EXAMPLES.

1. A Note dated January 1st, 1821, was given for $120, interest at 6 per cent., and there were the following payments endorsed upon it:

June 1, 1821, rec'd on the within note $50.
Oct. 1, 1821, rec'd 40.

I demand how much was due on said note, January 1, 1822, when it was taken up?

$	
120	Principal, or Sum of the note.
7,20cts.	Interest for the whole time.
$127,20cts.	Amount.

$		$	
50	First payment.	40	Second payment.
1,75cts.	Interest.	0,60cts.	Interest.
51,75	Its amount.	40,60	Its amount.

$ c.		$ c.	
51,75	Several am'ts	127,20	Amount of Note.
40,60	of payments.	92,35	Amount of payments.
92,35	Total amount.	34,85	Due on the Note, Jan'y 1, 1822. *Ans.*

2. A Bond dated April 17th, 1817, was given for $675, interest at 6 per cent., and it was endorsed as follows:

May 7, 1818, received on the within $148.
August 17, 1820, received 341.
Jan. 2, 1822, received 99.

I demand what was due on said bond, June 17, 1822, when it was paid up? *Ans.* $219,52cts.

3. A bond or note was given, June 4th, 1819, for $699, interest at 6 per cent.; it was endorsed $78, July 9, 1820; $147, Nov. 27, 1821; $68, Jan'y 17, 1822; and $400, Jan'y 30, 1823;—I demand how much will be due on said note, May 30, 1823? *Ans.* $132,87cts. 1m.

£62 10s.

4. Value received, I promise to pay George Appleton, the sum of Sixty-two Pounds, Ten Shillings, and interest at 6 per cent. per annum, till paid.

PETER FRISBIE.

Halifax, April 4, 1820.

Endorsed, £50, Sept. 4, 1822.

If he endorse £12, 10s. June 1, 1823, how much will be due on said note, December 4, 1823?

Ans. £9 12s. 4½d.

Contraction of the rule at 6 *per cent.*

Rule.—Point off the right hand figure of each principal for a decimal; multiply each by its particular time, and add the products. If the principals be pounds, &c. the sum total will be shillings and decimals; but if Federal Money, halve it for dimes, interest; which, added to the last principal, gives the sum due on the note.

Take the first Example in the preceding Rule.

1st Principal,		$12,0×5 months.	=60,0
2d	do.	7,0×4	=28,0
3d	do.	3,0×3	=09,0

As it is Federal Money, divide by 2)97,0

48,5 dimes,

$=48\frac{5}{10}$ dimes, =$4,85cts. which added to the last principal, 30+4,85=34,85cts. amount due. *Ans.*

This is nearly the same Rule as that at pages 128—129.

For an Example in pounds, &c. take the last question in the preceding Rule.

1st Principal, £62 10s.=6,25s. by Rule, page 127.

Yrs.	m.	d.	£.	s.
1822	9	4	62	10
1820	4	4	50	0
2	5	0	12	10=2d Principal=1,25s.

12

29 months.

Yrs.	m.	d.
1823	6	1
1822	9	4
	8	27=8,9

Int. for 1mo.=6,25×29=181,25 (s. m. s.)

Int. for 1mo.=1,25×8,9= 11,125

192,375 shillings,
which=£9 12s. 4½d. *Ans.*

There being no principal left to which to add the above sum, that sum is itself the exact answer.

This is the same Rule as that at page 127.

NOTE.—If the last principal be overpaid by the last endorsement, take the sum thus overpaid, multiply it, in the same way, by the time, from that endorsement, up to the settlement, then add its dimes, interest, to itself, and subtract the sum from the interest of the Note's principals, as above found.

3. Gave a note for $500, Jan. 16, 1822, payable Nov. 16, 1826; $50 were endorsed thereon April 1, 1823; $400, July 16, 1824; $60, Sept. 1, 1825; how will the balance be at the date when payable.

$500=1st principal. 500—50=450=2d principal. 450—400=50=3d principal. Then the next endorsement overpays the sum borrowed. 60=3d endorsement. and 60—50, the 3d principal=$10 overpaid on the sum borrowed.

	mo			mo.	
1st prin.	$50,0×14,5=725,0		Overp'd	$1,0×26,5=26,5	
2d do.	45,0×15,5=697,5		And	2)26,5	
3d do.	5,0×13,5= 67,5			——	
	——		Dimes	13,25=$1.32½	
	2)1490,0		Add sum	10,00	
Then, $74,50	——			——	
11,32½ subtr.	745 dimes,			$11,32½	
——	or, $74,50cts.			——	

Ans. $63,17½ due on Note.

4. A note was given, May 10, 1821, for $675, interest at 6 per cent. Nov. 15, 1821, it was endorsed $150; April 30, 1822, $275; Dec. 1, 1822, $10; July 30, 1823, $45; March 10, 1824, $60, and Aug. 20, 1825, it was paid up; what was the last payment? *Ans.* $126,96½cts.

RULE 2.—The Supreme Court of Massachusetts, established the following more equitable Rule.—When there are endorsements, find the interest on the principal to the time of the first payment, add it to the principal, and from the sum subtract the payment then made; if the endorsement be not equal to the interest then due, cast the interest to the next endorsement, add the two endorsements together, and from the amount of the principal to that time, subtract their sum; on the remainder cast the interest to the time of the next endorsement subtracting each payment as you proceed, if it be not less than the interest then arisen on the principal sum; and so on to the date of giving up the obligation.

EXAMPLES.

1. A note was given, January 20th, 1821, for $360, 50cts.; September 10th, following, 260 dollars were endorsed, and December 20th, 1822, it was taken up; what was the last payment, interest at 6 per cent.; computing it by both rules, and showing their difference?

Yr.	*m.*	*d.*		*Yr.*	*m.*	*d.*	
1821	9	10	=Sept. 10.	1822	12	20	=Dec 20.
1821	1	20	=Jan. 20.	1821	9	10	=Sept. 10.
	7	20		1	3	1	

$. cts.		
360, 50	Note dated Jan. 20, 1821,	mo. d.
13, 81 9	Interest up to Sept. 10, 1821	=7 20
374, 31 9	Amount.	
200, 00 0	First payment deducted.	
174, 31 9	Due Sept. 10, 1821.	Yr. m.
13, 36 4	Interest to Dec. 20, 1822	=1 3½.
$187, 68 3	Last payment by Rule 2.	

Yr.	m.	d.
1822	12	20
1821	1	20
1	11	0

$. cts.		
360, 50	Note.	Yr. m.
41, 45 7	Interest up to Dec. 20, 1822	=1 11.
401, 95 7	Amount for the whole time.	
200, 00 0	First payment, Sept. 10, 1821.	Y. m. d.
15, 33 3	Interest up to Dec. 20, 1822	=1 3 10.
215, 33 3	Amount.	

$ cts. m.	
401, 95 7	Amount of note.
215, 33 3	Amount of payment.
186, 62 4	Last payment by Rule 1.

$ cts. m.	
187, 68 3	Due by Massachusetts' Rule.
186, 62 4	Due by common Rule.
1, 05 9	Difference.

2. A note was given Nov. 15, 1820, for $282, 56cts.; May 10, 1821, $96, 34cts. were endorsed; December 20, following, $174, 28cts.; May 10, 1822, $10, 50cts.; and November 15, following, $5, 25cts.;—what will be due on

said note June 10, 1823, reckoning interest at 6 per cent., computing by both rules, and showing their difference?

Answer. { By Massachusetts' rule $13, 164
By rule first - $11, 455

Difference $1, 709

3 An obligation was given, July 15, 1817, for $340, interest at 6 per cent., on which are the following payments; Dec. 25, following, $7,50cts.; June 10, 1818, $10, 25cts.; January 1, 1819, $15; *August* 16, 1820, $25,75cts.; November 1, 1821, $30; and December 25, 1822, $250; if it be taken up March 25, 1823, what sum will cancel it, by the Massachusetts' rule? *Ans.* $113, 53cts.

N. B.—The figures beyond mills, in the two preceding examples, are all omitted in casting.

4. If a note, given July 5, 1819, for $101, at 6 per cent., were endorsed July 5, 1820, $6; July 5, 1821, $6; July 5, 1822, $6; July 5, 1823, $6; July 5, 1824, $6; July 5, 1825, $6; July 5, 1826, $6; July 5, 1827, $6; July 5, 1828, $6; what would be due, July 5, 1829, by both rules, and how much more by the second rule than by the first?

Ans. { $107,60 by Mass. rule; $91,40 by common rule; and $16,20 more by the former than the latter.

COMPOUND INTEREST.

Compound Interest is what arises from the interest being added to the principal, and becoming a part of the principal, at the end of each stated time of payment.

Rule.—Find the Simple Interest of the given sum for one year, or the time of the first payment; add it to the principal, and find the interest on the amount for the next year or payment, and so on for the number of payments required. Subtract the principal from the last amount, and the remainder will be the compound interest.

EXAMPLES.

1. What is the compound interest of 406 dollars, for 3 years, at 6 per cent. per annum?

406	principal for the 1st year.	
6		
24,36	interest of do.	Add.
406,	principal for the 1st year.	
430,36	principal for the 2d year.	
6		
25,[illegible],6	interest of do.	Add.
430,36	principal for the 2d year.	
456,18,1	principal for the 3d year.	
6		
27,37,0,86	interest for do.	Add.
456,18,1	principal for the 3d year.	
483,55,1	amount for three years.	
406,	prin. for the 1st year, subtracted.	
Ans. $77,55,1	compound interest.	

2. How much is the compound interest of 2535 dollars for four years, at 6 per cent. per annum?

Ans. 665 dolls. 36cts.+

N. B.—The mills are here all rejected in casting.

3. What is the compound interest of 1000 dollars for 5 years, at 6 per cent? *Ans* 338dolls 22cts. 4mills.+

N. B.—The figures beyond mills are here omitted in casting. The next is done in whole numbers.

4. What is the compound interest of £128 17s. 6d. for 6 years, at 6 per cent.? *Ans*. £53 18s. 8d.+

5. How much will 680 dollars amount to in 4 years, at 6 per cent. compound interest.

Ans. $858 48cts. 3m.+

N. B.—Figures beyond mills omitted.

COMMISSION.*

Commission and Brokerage are compensations to factors and brokers for their respective services.

EXAMPLES.

1. What is the commission on 4760dolls. at $2\frac{1}{2}$ per cent.?

$$\begin{array}{r} 2)4760 \\ 2\frac{1}{2} \\ \hline 9520 \\ 2380 \\ \hline 119,00 \end{array}$$ Ans. 119 dollars.

2. What is the commission on £526 11s. 5d. at $3\frac{1}{2}$ per cent.? Ans. £18 8s. 7d.+

3. What is the brokerage on 926 dollars, 50 cents, at $1\frac{1}{2}$ per cent.? Ans. 13dolls. 89cts. 7m.+

4. What is the commission on 1298 dollars, 53 cents, at $\frac{3}{4}$ per cent.? Ans. 9dolls. 73cts. 8mills.+

5. Required the neat proceeds of certain goods amounting to 2176 dollars, deducting a commission of $\frac{7}{8}$ per cent.? Ans. 2156dolls. 96cts.

6. A factor receives 3690 dollars to lay out in potash, reserving from it his commission of $2\frac{1}{2}$ per cent. on the purchase; the potash being 190 dollars per ton, how much did he purchase? Ans. 18tons, 18cwt. 3qrs. $22\frac{2}{19}$lb.

INSURANCE.

Insurance is an exemption from hazard, by paying a certain sum on condition of being indemnified for loss or damage of ships, houses, merchandise, &c. which may happen from storms, fires, &c.

* The method of working questions in this and the following rules of insurance, &c. is the same as in Simple Interest.

M 2

EXAMPLES.

1. What is the premium of insuring 8250 dollars, at 6 per cent.?

8250
6

495,00 Ans. 495 dollars.

2. What is the premium of insuring 1650 dollars, at 15½ per cent.? *Ans.* 255dolls. 75cts.

3. What sum must be received for a policy of 1658 dollars, deducting a premium of 23 per cent. for insurance? Ans. 1276dolls. 66cts.

4. What is the premium for the insurance of 4000 dollars, at 7⅝ per cent.? Ans. 305 dollars.

5. What sum must be insured upon to cover 1800 dollars, when the premium is 10 per cent.?

100 Policy.
Deduct 10 Premium.

90 Sum covered.
If \$90 : \$100 : : \$1800 : \$2000 Ans.

DISCOUNT.

Discount is an allowance made for the payment of any sum of money before it becomes due; and is the difference between that sum due some time hence, and its present worth. The *present worth* of any sum, due some time hence, is such a sum, as, if put to interest, would in that time, and at the rate per cent. for which the discount is to be made, amount to the sum or debt then due.

Rule.—As the amount of 100 dollars for the given rate and time, is to the interest of 100 dollars for that time, so is the given sum or debt, to the discount required. Or, as the amount of 100 dollars or pounds, is to 100, so is the given sum or debt, to the present worth required.

Note.—When goods are bought or sold, money advanced, bank-bills exchanged, &c. and discount is to be

made at any rate per cent. without time, the interest of the sums as found for a year, is the discount.

EXAMPLES.

1. What is the discount of 1912 dollars, 50 cents due 3 years hence, at $4\frac{1}{2}$ per cent.?

```
  4.50
     3
  ----
 13,50
100,
------      $. cts.      $. cts.    $. cts.
$113,50 : 13,50  : :  1912,50 : 227,47+Ans.
```

2. What is the present worth of 760 dollars due in 8 months, discount at 6 per cent. per annum?

```
                 $.
8 mo. 2/3 6 = 4
                100
                ---     $.          $.
                104  :  100  :  :  760 :
```

Ans. 733dolls. 76cts. 9mills +

3. What is the present worth of 500 dollars payable in $\frac{1}{4}$ of a year, discount being at 5 per cent.?

Ans. $493,82$\frac{2}{3}$cts.+

NOTE.—When several sums are to be paid at various times, find the discount or present worth of each sum separately, and then add those discounts or present worths into one sum, in order to obtain the required answer.

4. A is to pay 592 dollars, 70 cents on the first day of April, 1807, and 594 dollars, 90 cents the first of July following. It is required to know how much money will discharge both sums on the first of January, 1807, discounting at 8 per cent. per annum.

Ans. 1156dolls 94cts. 3mills+.

5. Bought a quantity of goods for 500 dollars ready money, and sold them again for 665 dollars, 67 cents, payable at $\frac{3}{4}$ of a year; what was the gain in ready money, supposing discount to be made at 5 per cent.?

Ans. 142dolls. 57cts.+

6. How much ready money will discharge a note for 150 dollars due in 60 days, allowing 6 per cent. per annum discount? Ans. 148dolls. 51cts. 4mills.+

7. If a legacy of 2000 dollars be left to me; 500 dollars payable in 6 months; 800 in one year; and the rest at the end of 3 years; and the executor be willing to make me present payment, discounting at 6 per cent.; what ought I to receive? Ans. 1833dolls. 37cts. 4m.+

8. What is the present worth of £60, payable at 3 and 6 months, at 5 per cent. per annum discount?

Ans. £58 17s. 11d. $2\frac{2}{369}$qr.

ANNUITIES.

An Annuity is a yearly income arising from money, &c. and is either paid for a term of years, or upon a life. Annuities or pensions are said to be in *arrears*, when they are payable or due either yearly, half-yearly, or quarterly, and yet remain unpaid for any number of payments.

The sum of all the annuities, for the time they have been forborne, together with the interest due upon each, is called the *amount*.

If an annuity be bought off, or paid all at once at the beginning of the first year, the price which is paid for it, is called the *present worth*.

CASE I.

To find the amount of an annuity at Simple Interest.

Rule.—1. Find the interest of the given annuity for 1 year; and then for 2, 3, &c. years, up to the given time less 1: 2. Multiply the annuity by the number of years given, and add the product to the whole interest, and the sum will be the amount required.

EXAMPLES.

1. If 250 dollars, yearly annuity, be forborne 7 years, what will it amount to in that time, allowing simple interest at 6 per cent. per annum?

1st. Interest of \$250, at 6 per cent. for 1 year=\$15. 2yrs.=\$30 3yrs.=\$45. 4yrs.=\$60. 5yrs.=\$75. and 6yrs.=\$90. And 2d. \$250×7=\$1750.

Then, 15+30+45+60+75+90+1750=\$2065 Ans.

2. A house is leased for 7 years, at 400 dollars per annum; and the rent is unpaid during the whole term; what sum is due at the end of the lease, simple interest being allowed, at 6 per cent. per annum?

Ans. 3304 dollars.

CASE II.

To find the present worth of an annuity at Simple Interest.

RULE.—Find the present worth of each year by itself, discounting from the time it falls due; the sum of all these present worths, will be the present worth required.

NOTE.—The divisions are continued decimally.—But it is deemed more equitable to allow compound interest, in purchasing annuities.

EXAMPLES.

1. What is the present worth of 400 dollars per annum, to continue 5 years, at 6 per cent. per annum?

$$\left.\begin{matrix}106\\112\\118\\124\\130\end{matrix}\right\}: 100 : : 400 : \left\{\begin{array}{lr}377,35849 = \text{present worth of 1 yr.} & \\ 357,14285 = & \text{2d yr.}\\ 338,98305 = & \text{3d yr.}\\ 322,58064 = & \text{4th yr.}\\ 307,6923 \;\; = & \text{5th yr.}\end{array}\right.$$

Ans. \$1703,75733=\$1703,75cts. 7m.

2. What is a salary of \$300 per annum, to continue 5 years, worth in ready money, at 5 per cent. per annum?

Ans. \$1309,31cts.+

3. What is £250 yearly rent, to continue 6 years, worth in ready money, at 3 per cent.?

Ans. £1360 7s. 10¾d.+

EQUATION OF PAYMENTS.

EQUATION OF PAYMENTS is finding a time to pay at once several debts due at different times, so that no loss shall be sustained by either party.

RULE.—Multiply each payment by the time at which it is due; then divide the sum of the products by the sum of the payments, and the quotient will be the time required.

EXAMPLES.

1. A owes B. 1900 dollars, to be paid as follows, viz. 500 dollars in 6 months, 600 dollars in 7 months, and 800 dollars in 10 months; what is the equated time to pay the whole debt?

$$500\times 6=3000$$
$$600\times 7=4200$$
$$800\times 10=8000$$

1900)15200(8 months. *Ans.*
15200

2. A owes B 240 dollars, to be paid in six months; but in $1\frac{1}{2}$ months pays him 60 dollars, and in $4\frac{1}{2}$ months after that 80 dollars more; how much longer than six months should A in equity defer the rest? *Ans.* $2\frac{7}{10}$ months.

3. I owe 6512 dollars, to be paid $\frac{1}{4}$ in 3 months, $\frac{1}{2}$ in 5 months, $\frac{1}{8}$ in 10 months, and the remainder in 14 months; at what time ought the whole to be paid?

Ans. $6\frac{1}{4}$ months.

4. A owes 60 dollars to be paid in 90 days, 75 dollars in 60 days, and 50 dollars in 30 days; what is the equated time for the whole to be paid? *Ans.* $61\frac{6}{10}$ days.+

EXCHANGE.

By this rule merchants know what sum of money ought to be received in one country, for a given sum of different specie paid in another, according to a given course of exchange.

By the following table the moneys of foreign nations may be reduced to that of the United States.

TABLE

Shewing the value of the coins or moneys of account, of foreign nations, estimated in Federal Money, agreeably to a law of the United States in most instances.

	$	cts.
Pound Sterling of Great Britain, -	4	44
Pound Sterling of Ireland, - -	4	10
Livre of France, - - -	0	18½
Guilder, or Florin, of Holland, - -	0	39
Marc Banco of Hamburgh, - -	0	33⅓
Rix Dollar of Denmark, and Germany,	1	00
Rial Plate of Spain, - - -	0	10
Milre of Portugal, - - -	1	24
Tale of China and Japan, - -	1	48
Pagoda of India, - - -	1	94
Rupee of Bengal, - - -	0	55½
Ruble of Russia, - - -	1	00
Testoon of Italy, - - -	0	23⅘
Pound English W. I. Islands, - -	3	16⅔
Livre French W. I. Islands, - -	0	13⅘
Franc of France, - - -	0	18 7/10
Rix Dollar of Sweden, - -	1	03 7/10
Do. do. of Austria, - - -	0	77 7/10
Do. do. of Poland and Prussia, -	0	77 7/10
Medio of Morocco, - - -	1	03 7/10
Piaster of Arabia, - - -	1	00
Or of Persia, - - - -	1	48

1.—*Of Great Britain.*

EXAMPLES.

1. In £45 10s. sterling, how many dollars and cents?

A pound sterling being =444 cents. Therefore, as £1 : 444cts. : : 45,5£. : 20202cts.=$202,02cts. Ans.

2. In $500 how many pounds sterling?

As 444cts. : £1 : : 50000cts. : £112 12s. 3d.+Ans.

Note.—This method is not so exact as that given in Reduction of Currencies.

2—*Of Ireland.*

1. In £85 7s. 6d. Irish money, how many cents?
£1 Irish=410cents.

£. cts £. cts. $ cts.
Therefore, as 1 : 410 : : 85,375 : 35003¾=350,03¾.

2. In $176,30cts., how many pounds Irish?
As 410cts. : £1 : : 17630cts. : £43 Irish. *Ans.*

3.—*Of France.*

Accounts are there kept in livres, sols, and deniers.

{ 12 deniers, or pence, make 1 sol, or shilling.
{ 20 sols, or shillings, 1 livre, or pound.

EXAMPLES.

1. In 360 livres, 12 sols, how many dollars and cents?
1 livre of France=18½cts. or 185 mills.

l. *m.* *l.* *m.*
As 1 : 185 : : 360,6 : 66711=$66,71cts. 1m. *Ans.*

2. What sum of French money is equal to $94,52cts. 8m.? *m.* *liv.* *m.* *liv.* *so* *den.*
As 185 : 1 : : 94528 : 510 19 2+ Ans.

4.—*Of Holland, &c.*

Accounts are kept there in guilders, stivers, grotes, and peningens.

{ 8 peningens make 1 grote, or penny.
{ 2 grotes - 1 stiver.
{ 20 stivers - 1 guilder, or florin.

1 guilder=39 cents=390 mills.

EXAMPLES.

In 250 guilders, 16 stivers, how much Federal Money?
guil. *cts.* *guil.* *$* *d.* *cts.* *m.*
As 1 : 39 : : 250,8 : 97 8 1 2 Ans.

m. *g.* *m.* *g.*
As 390 : 1 : : 97812 : 250,8 Proof.

5.—*Of Hamburgh, in Germany.*

Accounts are kept in Hamburgh, in marcs, shillings, and fennings, and by some in rix dollars.

12 fennings make 1 shilling lub.
16 shillings - 1 marc.
3 marcs - 1 rix dollar.
1 marc=33⅓cts. or one third of a dollar.

RULE 1.—Divide the marcs by 3, and the quotient will be dollars.

EXAMPLE.

Bring 584 marcs, 12 shillings to Federal Money.

3)584,75

$194,91c. 6⅔m. Ans.

RULE 2.—When the given sum is Federal Money, multiply it by 3, and the product will be marcs and decimal parts.

EXAMPLE.

In $315,70cts. how much Hamburgh, &c. money?

315,70
3

947,10=947 marcs, 1 shil. 7,2 fennings. Ans.

6.—Of Spain.

In Spain, they keep their accounts in piastres, rials, and maravedies.

34 maravedies of plate make 1 rial of plate.
8 rials of plate make 1 piastre, or piece of 8.
1 rial=10 cents, or 1 dime.

RULE 1.—To reduce rials to Federal Money, point off the right hand figure of the given sum, and as it stands, it is the answer in dollars and dimes.

EXAMPLE.

In 968 rials, how many dollars, &c.?
Ans. 96,8=$96,8 dimes, or $96,80cts.

RULE 2.—To reduce cents into rials, divide the cents by 10.

EXAMPLE.

In $94,65cts. how many rials, &c.?

9465÷10=946,5=946 rials, 17 maravedies. Ans.

7.—*Of Portugal.*

In Portugal, accounts are kept in milrez and rez, reckoning 1000 rez to a *milre*, as its name imports.

1 milre=124 cents.

Rule 1.—To reduce milrez into Federal Money, multiply the given sum by 124, and the product will be cents; if the given sum contain rez, multiply as before, and cut off 3 figures from the right of the product; the answer will be cents, and decimals of a cent. If the rez are less than 100, prefix a cipher to them, before you annex them to the milrez. A comma, or decimal point, is used to separate rez and milrez.

EXAMPLES.

1. In 580 milrez how many cents.?

580×124=71920 cents=$719,20cts. Ans.

2. In 125 milrez, 96 rez, how many cents?

125,096×124=15511,904cts. or $155,11cts. 9m.+Ans.

Rule 2.—To reduce cents into milrez, divide the sum by 124, and if decimals arise, continue the division to three places of decimals; the whole numbers in the quotient will be milrez, and the decimals will be rez.

EXAMPLES.

1. How many milrez in 6878 cents?

6878÷124=55,467+or 55milr. 467 rez. *Ans.*

2. In $31,09cts. 3 mills, how many milrez of Portugal?

c. m.

3109,3÷124=25,075=25milr. 75rez. *Ans.*

8.—*Of East-India Money.*

Rule.—To reduce India Money to Federal. Multiply tales of China by 148; pagodas of India by 194; and rupees of Bengal, by $55\frac{1}{2}$: and the product, in every case, will be cents. To change Federal Money into the before-

named moneys, divide the given sum by one of the above numbers, as the case may be.

EXAMPLES.

1. In 1000 tales of China, how many dollars?
Ans. $1480.
2. In 1420 tales of China, how many dollars, &c.?
Ans. $2101,60cts.
3. In $948,68cts. how many tales of China?
Ans. 641.
4. In 482 pagodas of India, how many dollars and cents? Ans. $935,8cts.
5. In $135,80cts. how many pagodas of India?
Ans. 70.
6. In 920 rupees of Bengal, how much Federal Money?
Ans. $510,6cts.
7. In $54, 39cts. how many rupees of Bengal?
Ans. 98.

A compound Example in European Money.

Suppose a merchant of Hallowell has effects at London, to the amount of $5460, which he can remit by way of Lisbon, at 1 milre per dollar, and thence to Boston, at $1,50cts. per milre; or by way of Paris, at 5 livres per dollar; thence to Brest, at 6 livres per crown, and thence to Washington, at $1,25cts. per crown; which will be the most advantageous way of remitting?

Ans. { Remitting by way of Lisbon is most advantageous by $2502,50cts.

VULGAR FRACTIONS.

Vulgar Fractions were briefly introduced immediately after Duodecimals; and some general definitions, and a few such problems as were necessary to prepare the scholar for, and to lead him into decimals, were there given. Those general definitions he is requested to read anew.

Vulgar Fractions are either proper, improper, single, compound or mixed.

1. A *proper fraction* is when the numerator is less than the denominator: as, $\frac{3}{4}$, $\frac{4}{5}$, $\frac{5}{8}$, &c. which mean $\frac{3}{4}$ of 1, $\frac{4}{5}$ of 1, $\frac{5}{8}$ of 1, &c.

2. An *improper fraction* is when the numerator exceeds the denominator: as, $\frac{8}{3}$, $\frac{110}{21}$, &c.

3. A *single fraction* is a simple expression for any number of parts of the integer.

4. A *compound fraction* is the fraction of a fraction: as, $\frac{1}{2}$ of $\frac{2}{3}$, $\frac{3}{4}$ of $\frac{7}{8}$, &c., which mean $\frac{1}{2}$ of $\frac{2}{3}$ of 1, $\frac{3}{4}$ of $\frac{7}{8}$ of 1, &c.

5. A *mixed number* is composed of a whole number and a fraction; as, $8\frac{1}{5}$, $12\frac{9}{13}$, &c.

Note.—Any number may be expressed like a fraction by writing 1 under it: Thus $\frac{6}{1}$ means 6 ones or 6.

A fraction having a fraction or mixed number for its numerator or denominator, or both, is called a complex fraction. A fraction denotes division and its value is equal to the quotient obtained by dividing the numerator by the denominator: thus $\frac{12}{4}$ is equal to 3, and $\frac{20}{5}$ equal to 4. Therefore, if the numerator be less than the denominator, the value of the fraction is less than 1. If the numerator be the same as the denominator, the fraction is just equal to 1. And if the numerator be greater than the denominator, the fraction is greater than 1.

6. The *common measure* of two or more numbers is that number which will divide each of them without a remainder; and the *greatest* number that will do this, is called the *greatest common measure.*

7. A number which can be measured by two or more numbers, is called their *common multiple;* and if it be the *least* number, which can be so measured, it is called their *least common multiple.*

Problem 1.

To find the greatest common measure of two or more numbers.

Rule—1. If there be two numbers only, divide the greater by the less, and this divisor by the remainder, and

so on; always dividing the last divisor by the last remainder, until nothing remains; then will the last divisor be the greatest common measure required.

2. When there are more than two numbers, find the greatest common measure of two of them, as before; and next find the greatest common measure of that common measure and one of the other numbers; and so on, through all the numbers to the last; then will the greatest common measure last found be the answer.

3. If one happen to be the common measure, the given numbers are prime to each other, and found to be incommensurable.

EXAMPLES.

1. Required the greatest common measure of 918, 1998 and 522.

```
918)1998(2
    1836
    ----
     162)918(5
         810
         ---
         108)162(1
             108
             ---
              54)108(2
                 108
                 ---
```

So 54 is the greatest common measure of 1998 and 918— Hence

```
54)522(9
   486
   ---
    36)54(1
       36
       --
       18)36(2
          36
          --
```

Therefore 18 is the answer required.

2. What is the greatest common measure of 612 and 540? Ans. 36.

3. What is the greatest common measure of 117 and 91? Ans. 13.

PROBLEM 2.

To find the least common multiple of two or more numbers.

RULE.—1. Divide by any number, that will divide two or more of the given numbers without a remainder, and set the quotients, together with the undivided numbers, in a line beneath.

2. Divide the second line as before, and so on, until there are no two numbers that can be divided; then the

continued product of the divisors and quotients will give the multiple required.

EXAMPLES.

1. What is the least common multiple of 3, 5, 8, and 10?

```
2)3 5 8 10
  --------
5)3 5 4  5
  --------
  3 1 4  1   Then 2×5×3×4=120. Ans.
```

2. What is the least common multiple of 9, 8, 15, 16?
Ans. 720.

3. What is the least number that 3, 4, 8, and 12 will measure? Ans. 24.

4. What is the least number that can be divided by the 9 digits without a remainder. Ans. 2520.

REDUCTION OF VULGAR FRACTIONS.

Reduction of Vulgar Fractions is the bringing them out of one form into another, in order to prepare them for the operations of addition, subtraction, &c.

CASE I.

To abbreviate or reduce fractions to their lowest terms.

Rule.—Divide the terms of the given fraction by any number that will divide them without a remainder, &c. as in Rule of Problem 1, page 76. Or divide both the terms of the fraction by their greatest common measure, and the quotients will be the terms of the fraction required. If a fraction have ciphers on the right hand of both its terms, it may be reduced by cutting off an equal number from both.

EXAMPLES.

1. Reduce $\frac{144}{240}$ to its lowest terms.

$$\begin{array}{cccc} (4) & (3) & (4) & \\ \frac{144}{240}= & \frac{36}{60}= & \frac{12}{20}= & \frac{3}{5} \end{array} \text{ the answer.}$$

Or thus,

$$\begin{array}{l} 144)240(1 \\ \quad\;\; 144 \\ \quad\;\; \overline{96)144(1} \\ \qquad\qquad 96 \\ \qquad\qquad \overline{48)96(2} \\ \qquad\qquad\quad 96 \end{array}$$

Therefore 48 is the greatest common measure, and $48)\frac{144}{240}=\frac{3}{5}$. *Ans.*

NOTE.—1. Any number ending with an even number, or a cipher, is divisible by 2.

2. Any number ending with 5 or 0, is divisible by 5.

3. If the right hand place of any number be 0, the whole is divisible by 10.

4. If the two right hand figures, of any number are divisible by 4, the whole is divisible by 4.

5. If the sum of the digits, constituting any number, be divisible by 3 or 9, the whole is divisible by 3 or 9.

6. All prime numbers, except 2 and 5, have 1, 3, 7, or 9, in the place of units; and consequently all other numbers are composite, and capable of being divided.

7. When numbers with the sign of addition or subtraction between them, are to be divided by any number, each of the numbers must be divided. Thus,

$$\frac{4+8+10}{2}=2+4+5=11$$

8. But if the numbers have the sign of multiplication between them, only one of them must be divided. Thus,

$$\frac{3\times8\times10}{2\times6}=\frac{\times3\times4\times10}{1\times6}=\frac{1\times4\times10}{1\times2}=\frac{1\times2\times10}{1\times1}=\frac{20}{1}=20$$

9. If both the numerator and denominator of a fraction be multiplied or divided by the same number, the fraction will still retain its original value.

Let $\frac{4}{5}$ and $\frac{9}{12}$ be two fractions proposed; then $\frac{4}{5}\times\frac{2}{2}=\frac{8}{10}$; and $\frac{9}{12}\div\frac{3}{3}=\frac{3}{4}$. That is, if the numerator 4, and denom-

inator 5, of the first fraction, be each multipled by the same number 2, the produced fraction $\frac{8}{10}$ is equal to the proposed one $\frac{4}{5}$. For the numerator and denominator of the produced fraction, are in the same proportion as the numerator and denominator of the proposed one: Also, if the numerator 9, and the denominator 12, of the second fraction, be each divided by the same number 3, the fractions $\frac{3}{4}$ and $\frac{9}{12}$ are equal for the same reason.

2. Reduce $\frac{48}{272}$ to its lowest terms. Ans. $\frac{3}{17}$.
3. Reduce $\frac{60}{125}$ to its lowest terms. Ans. $\frac{12}{25}$.
4. Reduce $\frac{498}{1184}$ to its lowest terms. Ans. $\frac{249}{592}$.
5. Reduce $\frac{3619}{6251}$ to its lowest terms. Ans. $\frac{11}{19}$.

CASE II.

To reduce a mixed number to its equivalent improper fraction.

Rule.—Multiply the whole number by the denominator of the fraction, and add the numerator to the product; then that sum written above the denominator, will form the fraction required.

EXAMPLES.

1. Reduce $27\frac{2}{9}$ to its equivalent improper fraction.

$$\begin{array}{r} 27 \\ 9 \\ \hline 243 \\ 2 \\ \hline 245 \end{array}$$

$$\frac{245}{9} \quad \text{Or } \frac{27\times9+2}{9}=\frac{245}{9} \text{ the answer.}$$

2. Reduce $514\frac{5}{16}$ to an improper fraction Ans. $\frac{8229}{16}$.
3. Reduce $12\frac{15}{17}$ to an improper fraction. Ans. $\frac{219}{17}$.
4. Reduce $79\frac{12}{19}$ to an improper fraction. Ans. $\frac{1513}{19}$.
5. Reduce $100\frac{19}{59}$ to an improper fraction. Ans. $\frac{5919}{59}$.

CASE III.

To reduce an improper fraction to its equivalent whole or mixed number.

Rule.—Divide the numerator by the denominator, and the quotient will be the whole or mixed number required.

EXAMPLES.

1. Reduce $\frac{981}{16}$ to its equivalent whole or mixed number.

$$\begin{array}{l} 16)981(61\frac{5}{16} \\ 96 \\ \hline 21 \\ 16 \\ \hline 5 \end{array}$$

5 or $\frac{981}{16}=981\div16=61\frac{5}{16}$ the answer.

2. Reduce $\frac{219}{17}$ to its equivalent whole or mixed number. Ans. $12\frac{15}{17}$.

3. Reduce $\frac{126}{48}$ to its equivalent whole or mixed number. Ans. $2\frac{5}{8}$.

4. Reduce $\frac{56}{8}$ to its equivalent whole or mixed number. *Ans.* 7.

5. Reduce $\frac{621613}{514}$ to its proper terms. Ans. $1209\frac{187}{514}$.

CASE IV.

To reduce a whole number to an equivalent fraction, having a given denominator.

Rule.—Multiply the whole number by the given denominator, and place the product over the said denominator, and it will form the fraction required.

EXAMPLES.

1. Reduce 7 to a fraction, whose denominator shall be 9. $7\times9=63$, and $\frac{63}{9}$ Answer.
And $\frac{63}{9}=63\div9=7$ Proof.

2. Reduce 13 to a fraction, whose denominator shall be 12. *Ans.* $\frac{156}{12}$.

3. Reduce 746 to a fraction, whose denominator shall be 60. Ans. $\frac{44760}{60}$.

CASE V.

To reduce a compound fraction to an equivalent single one.

RULE.—Multiply all the numerators together for the numerator, and all the denominators together for the denominator, and they will form the fraction required.

If part of the compound fraction be a whole or mixed number, it must be reduced to an improper fraction by one of the former cases.

When it can be done, divide any two terms of the fraction by the same number, and use the quotients instead thereof.

EXAMPLES.

1. Reduce $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{4}{5}$ of $\frac{8}{11}$ to a single fraction.

$$\frac{2\times3\times4\times8}{3\times4\times5\times11}=\frac{192}{660}=\frac{16}{55}$$ the answer.—Or, by expunging equal numerators and equal denominators, the answer will be as before, $=\frac{16}{55}$.

2. Reduce $\frac{2}{3}$ of $\frac{3}{5}$ of $\frac{5}{8}$ to a single fraction. *Ans.* $\frac{1}{4}$:

3. Reduce $\frac{1}{12}$ of $\frac{7}{13}$ of $\frac{8}{19}$ of 10 to a single fraction. *Ans.* $\frac{1540}{711}$.

4. Reduce $\frac{1}{2}$ of $\frac{8}{9}$ of $\frac{6}{7}$ to a single fraction. Ans. $8\frac{8}{21}$.

CASE VI.

To reduce fractions of different denominators to equivalent fractions, having a common denominator.

RULE.—Multiply each numerator into all the denominators except its own, for a new numerator; and all the denominators continually for the common denominator; first reducing the fractions to their lowest terms, &c.

NOTE.—By Note 9, in Case 1, it will be seen, that several fractions of different denominators may be readily reduced to a common denominator. Thus $\frac{1}{3}$ may be reduced to the same denominator as $\frac{2}{9}$, by multiplying its terms by 3, by which it becomes $\frac{3}{9}$. Also $\frac{1}{2}$, $\frac{3}{4}$, and $\frac{5}{60}$, may be reduced to a common denominator, by multiplying the terms of the first fraction by 6, of the second by 3, and dividing those of the last by 5. And so of others.

EXAMPLES.

1. Reduce $\frac{1}{2}$, $\frac{3}{5}$, and $\frac{4}{7}$ to equivalent fractions, having a common denominator.

$1\times5\times7=35$ the new numerator for $\frac{1}{2}$.
$3\times2\times7=42$ do. do. $\frac{3}{5}$.
$4\times2\times5=40$ do. do. $\frac{4}{7}$.
$2\times5\times7=70$ the common denominator.

Therefore the equivalent fractions are $\frac{35}{70}$, $\frac{42}{70}$, and $\frac{40}{70}$. the answer.

2. Reduce $\frac{6}{10}$, $\frac{4}{8}$, $\frac{1}{9}$, and $\frac{6}{7}$ to equivalent fractions, having a common denominator. Ans. $\frac{378}{630}$, $\frac{315}{630}$, $\frac{70}{630}$, and $\frac{540}{630}$,

3. Reduce $\frac{1}{3}$, $\frac{3}{4}$ of $\frac{4}{5}$, $5\frac{1}{2}$ and $\frac{2}{19}$ to a common denominator. *Ans.* $\frac{190}{570}$, $\frac{342}{570}$, $\frac{3135}{570}$, $\frac{60}{570}$.

4. Reduce $\frac{11}{13}$, $\frac{3}{4}$ of $1\frac{1}{4}$, $\frac{9}{11}$ and $\frac{5}{7}$ to a common denominator. *Ans.* $\frac{13552}{16016}$, $\frac{15015}{16016}$, $\frac{13104}{16016}$, $\frac{11440}{16016}$.

CASE VII.

To find the value of a fraction in any known parts of the integer.

RULE.—Multiply the numerator by the parts in the next inferiour denomination, and divide the product by the denominator; and if anything remain, multiply it by the next inferiour denominator, and divide by the denominator as before; and so on, as far as necessary; and the quotients placed after one another, in their order, will be the answer required.

EXAMPLES.

1. What is the value of $\frac{3}{8}$ of a shilling? Ans. $4\frac{1}{2}$d.

```
   3
  12
  --
8)36(4d.
  32
  --
   4
   4
  --
8)16(2qrs.
  16
```

2. What is the value of $\frac{5}{12}$ of a dollar?

Ans. 41 cents, $6\frac{2}{3}$ mills.

3. What is the value of $\frac{4}{7}$ of a mile?

Ans. 4fur. 22pol. 4yds. $2\frac{1}{7}$ft.

4. What is the value of $\frac{4}{5}$ of a month?

Ans. 3w. 1d. 9h. 36m.

5. What is the value of $\frac{7}{16}$ of an acre?

Ans. 1 rood, 30 poles.

6. What is the value of $\frac{3}{5}$ of $\frac{5}{9}$ of $\frac{1}{3}$ of \$49,95 cents?

Ans. \$5,55 cents.

CASE VIII.

To reduce a fraction of one denomination to that of another, retaining the same value.

Rule.—Make a compound fraction of it, and reduce it to a single one.

EXAMPLES.

1. Reduce $\frac{5}{6}$ of a penny to the fraction of a pound.

$\frac{5}{6}$ of $\frac{1}{12}$ of $\frac{1}{20}=\frac{5}{1440}=\frac{1}{288}$, the answer.

And $\frac{1}{288}$ of $\frac{20}{1}$ of $\frac{12}{1}=\frac{240}{288}=\frac{5}{6}$d. the proof.

2. Reduce $\frac{1}{2}$ of a farthing to the fraction of a pound.

Ans. $\frac{1}{1920}$.

3. Reduce $\frac{4}{11}$ of a mill to the fraction of a dollar.

Ans. $\frac{1}{2750}$.

4. Reduce $\frac{1}{18}$£ to the fraction of a penny.

Ans. $\frac{40}{3}=13\frac{1}{3}$d.

5. Reduce $\frac{6}{7}$ of a pound Avoirdupois to the fraction of an cwt.

Ans. $\frac{6}{784}=\frac{3}{392}$.

6. Reduce $\frac{3}{13}$ of a month to the fraction of a day.

Ans. $\frac{84}{13}=6\frac{6}{13}$.

7. Reduce 7s. 3d. to the fraction of a pound.

s.	*d.*		*s.*	
7	3		20	in a £.
12			12	
87	numerator.		240	denominator.

$\frac{87}{240}=\frac{29}{80}$. Ans.

8. Reduce 6 furlongs, 16 poles to the fraction of a mile.

Ans. $\frac{4}{5}$.

ADDITION OF VULGAR FRACTIONS.

Rule.—Reduce compound fractions to single ones; mixed numbers to improper fractions: fractions of different integers to those of the same; and all of them to a common denominator; then the sum of the numerators, written over the common denominator, will be the sum of the fractions required.

Note 1.—In adding mixed numbers that are not compounded with other fractions, find first the sum of the fractions, to which add the whole numbers of the given mixed number.

Note 2.—When adding fractions of money, weight, &c. reduce fractions of different integers to those of the same integer. Or, find the value of each fraction by Case 7, in Reduction, and then add them in their proper terms.

EXAMPLES.

1. Add $3\frac{5}{8}$, $\frac{7}{8}$, $\frac{4}{5}$ of $\frac{7}{8}$, and 7 together.

First, $3\frac{5}{8}=\frac{29}{8}$, $\frac{4}{5}$ of $\frac{7}{8}=\frac{28}{40}=\frac{7}{10}$, $7=\frac{7}{1}$.

Then the fractions are $\frac{29}{8}$, $\frac{7}{8}$, $\frac{7}{10}$ and $\frac{7}{1}$.

$$\begin{array}{r} 29\times8\times10\times\ 1=2320 \\ 7\times8\times10\times\ 1=\ \ 560 \\ 7\times8\times\ 8\times\ 1=\ \ 448 \\ 7\times8\times\ 8\times10=4480 \\ \hline 7808 \end{array}$$

$$\frac{7808}{8\times8\times10\times1=640}=12\tfrac{128}{640}=12\tfrac{1}{5}\ \text{Ans.}$$

2. Add $\frac{5}{8}$, $7\frac{1}{2}$, and $\frac{1}{3}$ of $\frac{3}{4}$ together. *Ans.* $8\frac{3}{8}$.
3. What is the sum of $\frac{1}{3}$ of 95 and $\frac{7}{8}$ of 14? Ans. $43\frac{11}{12}$.
4. Add 19, 7, and $\frac{1}{2}$ of $\frac{2}{3}$ together. *Ans.* $26\frac{1}{3}$.
5. Add $\frac{2}{3}$ and $17\frac{1}{2}$ together. *Ans.* $18\frac{1}{6}$.
6. What is the sum of £$\frac{1}{7}$, $\frac{2}{9}$s. and $\frac{5}{12}$ of a penny? *Ans.* $\frac{3139}{1008}$s. or 3s. 1d. $1\frac{19}{21}$qrs.
7. Add $\frac{2}{7}$ of £15, £$3\frac{3}{7}$, $\frac{1}{3}$ of $\frac{5}{7}$ of $\frac{3}{5}$ of a pound, and $\frac{2}{3}$ of $\frac{3}{7}$ of a shilling together. *Ans.* £7 17s. $5\frac{1}{7}$d.
8. Add $\frac{2}{3}$ of a yard, $\frac{3}{4}$ of a foot, and $\frac{3}{8}$ of a mile together. Ans. 660yds. 2ft. 9in.
9. Add $\frac{1}{3}$ of a week, $\frac{1}{4}$ of a day, and $\frac{1}{2}$ of an hour together. *Ans.* 2 days, 14 $\frac{1}{4}$hours.

10. Add $\frac{4}{7}$ of a ton to $\frac{9}{10}$ of an hundred weight, 25lb. a qr. *Ans.* 12cwt. 1qr. 7lb. 13oz. $11\frac{3}{7}$drs.

11. Suppose I have $\frac{3}{8}$ of a ship worth $6000, and that I buy another person's share of her, which is $\frac{5}{16}$; what part of her belongs to me then, and what is it worth?

Ans. I have $\frac{11}{16}$, and it is worth $4125.

SUBTRACTION OF VULGAR FRACTIONS.

RULE.—Prepare the fractions as in addition, and the difference of the numerators written above the common denominator, will give the difference of the fractions required.

NOTE 1.—In subtracting mixed numbers, when the fraction in the subtrahend is greater than that in the minuend, subtract the numerator of the subtrahend from the denominator, and to the difference add the numerator of the minuend, and carry one to the integer in the subtrahend. If the minuend contain no fraction, proceed in the same way, there being then nothing to add to the difference.

NOTE 2.—In fractions of money, weights, &c. you may find the value of each of the given fractions, by Case 7, in Reduction, and then subtract them in their proper terms.

EXAMPLES.

1. From $\frac{2}{3}$ take $\frac{2}{9}$ of $\frac{3}{7}$.

$\frac{2}{9}$ of $\frac{3}{7}=\frac{2}{21}$; and $\frac{2}{3}=\frac{14}{21}$.

$\frac{14}{21}-\frac{2}{21}=\frac{12}{21}=\frac{4}{7}$, the answer.

2. From $\frac{111}{112}$ take $\frac{3}{4}$. *Ans.* $\frac{27}{112}$.

3. From $71\frac{1}{2}$ take $\frac{17}{19}$. *Ans.* $70\frac{23}{38}$

4. From £$\frac{7}{8}$ take $\frac{3}{4}$ of a shilling. *Ans.* 16s. 9d.

5. From $\frac{3}{5}$oz. take $\frac{7}{8}$ of a pennyweight. *Ans.* 11dwt. 3grs.

6. From $\frac{1}{2}$cwt. take $\frac{7}{12}$ of a pound. *Ans.* 1qr. 27lb. 6oz. $10\frac{2}{3}$ drams.

7. From 7 weeks take 9 days $\frac{7}{15}$. *Ans.* 5w. 4d. 7h. 12m.

8. From 4 days $7\frac{1}{2}$ hours take 1 day 9 hours $\frac{3}{18}$. *Ans.* 2d. 22h. 20m.

9. Suppose I own $\frac{5}{8}$ of a farm, which is worth \$3600, and that I sell $\frac{2}{3}$ of my share; what part of it have I left, and what is it worth?

Ans. $\frac{5}{24}$; and worth \$750.

MULTIPLICATION OF VULGAR FRACTIONS.

Rule.—Reduce compound fractions to single ones, mixed numbers to improper fractions, and those of different integers to the same; then multiply all the numerators together for the numerator, and multiply all the denominators together for the denominator of the product required. But always, before multiplying, cancel equal numerators and denominators, and divide those that are divisible by the same numbers, both here and in division, agreeably to what is seen in Note 8 of Case 1, in Reduction, page 150, and in Case 5, page 154.

Note.—A fraction is best multiplied by an integer, by dividing the denominator by it, if possible, but if that cannot be done, multiply the numerator by it.

EXAMPLES.

1. Required the continued product of $2\frac{1}{2}$, $\frac{1}{8}$, $\frac{1}{3}$ of $\frac{5}{6}$, and 2.

$$2\tfrac{1}{2}=\tfrac{5}{2},\ \tfrac{1}{3}\text{ of }\tfrac{5}{6}=\frac{1\times5}{3\times6}=\tfrac{5}{18},\text{ and }2=\tfrac{2}{1}$$

$$\text{Then }\tfrac{5}{2}\times\tfrac{1}{8}\times\tfrac{5}{18}\times\tfrac{2}{1}=\frac{5\times1\times5\times2}{2\times8\times18\times1}=\tfrac{25}{144}\ \textit{Ans.}$$

2. Multiply $\frac{3}{7}$ by $\frac{3}{11}$. *Ans.* $\frac{9}{77}$.
3. Multiply $4\frac{1}{2}$ by $\frac{1}{8}$. *Ans.* $\frac{9}{16}$.
4. Multiply $\frac{3}{5}$ of 8, by $\frac{7}{8}$ of 5. *Ans.* 21.
5. Multiply $7\frac{1}{2}$ by $9\frac{1}{4}$. *Ans.* $69\frac{3}{8}$.
6. Multiply $4\frac{1}{2}$, $\frac{3}{4}$ of $\frac{1}{7}$, and $18\frac{4}{5}$ continually together. Ans. $9\frac{9}{140}$.
7. What is the product of 5, $\frac{2}{3}$, $\frac{2}{7}$ of $\frac{3}{5}$, and $4\frac{1}{6}$? *Ans.* $2\frac{8}{21}$.

DIVISION OF VULGAR FRACTIONS.

Rule.—Prepare the fractions as in Multiplication; then invert the divisor, and proceed as in Multiplication. The product will be the quotient required.

NOTE.—A fraction is divided by an integer, by dividing the numerator by it, if possible, but if it will not exactly divide, then multiply the denominator by it.

EXAMPLES.

1. Divide $\frac{1}{5}$ of 19 by $\frac{2}{3}$ of $\frac{3}{4}$.

$$\tfrac{1}{5} \text{ of } 19 = \frac{1\times19}{5\times\ 1} = \frac{19}{5}, \text{ and } \tfrac{2}{3} \text{ of } \tfrac{3}{4} = \tfrac{6}{12} = \tfrac{1}{2};$$

$$\tfrac{19}{5}\times\tfrac{2}{1} = \frac{19\times2}{5\times1} = \tfrac{38}{5} = 7\tfrac{3}{5} \text{ the quotient required.}$$

2. Divide $\frac{17}{21}$ by $\frac{3}{5}$. Ans. $1\frac{22}{63}$.
3. Divide 99 by 108. Ans. $\frac{99}{108}=\frac{11}{12}$.
4. Divide $\frac{2}{3}$ of $\frac{3}{4}$ by $\frac{1}{2}$ of $\frac{2}{3}$. Ans. $1\frac{1}{2}$.
5. Divide $3\frac{1}{6}$ by $9\frac{1}{2}$. Ans. $\frac{1}{3}$.
6. Divide $\frac{7}{8}$ by 4. Ans. $\frac{7}{32}$.

RULE OF THREE IN VULGAR FRACTIONS.

RULE.—Prepare the fractions as in Multiplication; and state the question as directed in the Rule of Three in whole numbers; then invert the first term in the stating, and multiply all the three terms continually together, numerators by numerators and denominators by denominators, and the product will be the answer in the same name as the second or middle term.

EXAMPLES.

1. If $\frac{3}{5}$ of a yard cost $\frac{7}{12}$ of a pound, what will $\frac{6}{15}$ of an Ell English cost?

$$\text{First } \tfrac{3}{5} \text{ of a yard} = \tfrac{3}{5} \text{ of } \tfrac{4}{1} \text{ of } \tfrac{1}{5} = \frac{3\times4\times1}{5\times1\times5} = \tfrac{12}{25} \text{ of an ell.}$$

	Ell.		*£.*		*Ell.*	
Then	$\frac{12}{25}$	:	$\frac{7}{12}$	: :	$\frac{6}{15}$	:

And $\frac{25}{12}\times\frac{7}{12}\times\frac{6}{15}=\frac{35}{72}$£$=9$s. $8\frac{2}{3}$d. Answer.

NOTE.—Here, 25 and 15 are divisible by 5, giving 5 and 3 for quotients; and 6 and one of the 12s are divisible by 6, giving 1 and 2 for quotients; then the numerators are 5, 7, and 1, whose product is 35; and the denominators 12, 2, and 3, whose product is 72. And thus always

EXAMPLES.

1. At what rate per cent. will $950,75 amount to $1235,975 in 5 years?

From the amount = 1235,975
Take the principal = 950,75

950,75×5=4753,75)285,2250(,06=6 per cent. Ans.

2. At what rate per cent. will £543 amount to £705 18s. in 5 years? Ans. 6 per cent.

3. At what rate per cent. will $2124,25 amount to $3482,44234375 in $7\frac{3}{4}$ years? *Ans.* $8\frac{1}{4}$ per cent.

CASE 4.—*The amount, principal, and rate per cent. given, to find the time.*

RULE.—Subtract the principal from the amount; divide the remainder by the product of the ratio and principal; and the quotient will be the time.

EXAMPLES.

1. In what time will $248,39 amount to $270,7451 at 6 per cent. per annum?

From the amount $270,7451
Take the principal 248 39

248,39×,06=14,9034)22,3551(1,5=$1\frac{1}{2}$ year. Ans.

2. In what time will £543 amount to £705 18s. at 6 per cent. per annum? Ans. 5 years.

3. In what time will $2142,25 amount to $3482,4423-4375 at $8\frac{1}{4}$ per cent. per annum? Ans. $7\frac{3}{4}$ years.

TO CALCULATE INTEREST FOR DAYS.

A TABLE OF RATIOS FOR DAYS.

Rate per cent.	Ratios.	Rate per cent.	Ratios.
$4\frac{1}{2}$	=,00012328767	6	=,00016438356
5	=,0001369863	$6\frac{1}{2}$	=,00017808219
$5\frac{1}{2}$	=,00015068493	7	=,00019178082

RULE.—Multiply the principal by the given number of days, and that product by the ratio for a year; divide the last product by 365, (the number of days in a year,) and it

will give the interest required. Or, multiply the ratio for a day in the foregoing table by the principal, and that product by the given number of days; and the last product will be the interest required.

EXAMPLES.

1. What is the interest of £360, 10s. for 146 days, at 6 per cent.?

$$\frac{360{,}5\times146\times{,}06}{365} \overset{£.}{=} 8{,}652 = \overset{£.}{8}\ \overset{s.}{13}\ \overset{d.}{0}\ \overset{qr.}{1{,}92}\ \text{Ans.}$$

Or ,00016438356×360,5×146=£8,6519990+Ans.

2. What is the interest of $780,40cts. for 100 days, at 6 per cent. per annum? *A*ns. $12,82cts. 8m.+

3. What is the interest of $181,75cts. for 25 days at 7 per cent. per annum? Ans. $2,30cts. 9m.+

NOTE.—The interest of any sum for 6 days, at 6 per cent., is just as many mills and decimals of a mill, as the principal contains dollars and decimals of a dollar. Therefore set down the principal, multiply it by the days, and divide the product by 6; the quotient will be the interest in mills and decimals of a mill. This is calling only 30 days a month.

What is the interest of $231,84 for 100 days?

$$\frac{231{,}84\times100\ \text{days}}{6} = 3864\text{m.}$$

Or $3,86 4; which is 5cts. 1m. too much; but when the time is less than 30 days, it gives the answer very exact, for ordinary sums.

When interest is to be calculated on cash accounts, &c. where partial payments are made, it is the common practice to multiply the several balances into the days they are at interest; then to multiply the sum of these products by the rate on the dollar, and divide the last product by 365; and thus cast the whole interest due on the account, &c.

EXAMPLES.

Lent John Joy, per bill on demand, dated 1st of June, 1821, $2000, of which I received back the 19th of August, $400; on the 15th of October, $600; on the 11th of December, $400; on the 17th of February, 1822, $200; and on the 1st of June, $400; how much interest is due on the bill, reckoning at 6 per cent.?

1821.	$	days.	products.
June 1. Principal, per bill,	2000	79	158000
Aug. 19. Received in part,	400		
Balance,	1600	57	91200
Oct. 15. Received in part,	600		
Balance,	1000	57	57000
Dec. 11. Received in part,	400		
1822. Balance,	600	68	40800
Feb. 17. Received in part,	200		
Balance,	400	104	41600
June 1. Rec'd in full of principal,	400		
			388600

Then 388600
,06 Ratio.

365)23316,00(63,879+. $. cts. m. Ans.=63,87 9

COMPOUND INTEREST BY DECIMALS.

A table showing the amount of £1 or $1 at 5 and 6 per cent. per annum, compound interest, for 20 years.

Yrs.	5 per cent.	6 per ct.	Yrs.	5 per cent.	6 per cent.
1	1,05000	1,06000	11	1,71033	1,89829
2	1,15250	1,12360	12	1,79585	2,01219
3	1,15762	1,19101	13	1,88564	2,13292
4	1,21550	1,26247	14	1,97993	2,26090
5	1,27628	1,33822	15	2,07892	2,39655
6	1,34009	1,41851	16	2,18287	2,54035
7	1,40710	1,50363	17	2,29201	2,69277
8	1,47745	1,59384	18	2,40661	2,85433
9	1,55132	1,68947	19	2,52695	3,02559
10	1,62889	1,79084	20	2,65329	3,20713

RULE.—Multiply the given principal continually by the amount of one pound, or one dollar, for one year, at the rate per cent. given, until the number of multiplications is equal to the given number of years, and the product will be the amount required.

Or, take from the preceding Table, the amount of one pound or one dollar, as the case may be, for the given number of years, and at the given rate per cent., and multiply it by the given principal, and it will give the amount as before.

EXAMPLES.

1. What will £400 amount to in 4 years, at 6 per cent. per annum, compound interest?

$400\times1,06\times1,06\times1,06\times1,06=$ £504,99+ or £504 19s. 9d. 2,4qrs.+ *Ans.*

Or, by the Table. Tabular amount of £1 = 1,26247
Multiply by the principal, 400

Whole amount, £504,98800

2. What is the compound interest of $555 for 14 years, at 5 per cent.? $543,86cts.+

Note.—Any sum of money, at 6 per cent. per annum, simple interest, will double in $16\frac{2}{3}$ years; but at 6 per cent. per annum, compound interest, it will double in 11 years and 325 days, or 11,889 years.

ANNUITIES AT COMPOUND INTEREST

Case 1.—*To find the amount of an annuity, &c.*

Rule.—Raise the amount of $1, or £1, at the given rate per cent., for one year, to that *power* denoted by the given number of years; subtract *unity* or 1 from this product; multiply the remainder by the given annuity; divide this last product by the ratio made less by *unity* or 1; and the quotient will be the amount sought.

EXAMPLES.

1. If $250, yearly pension, be forborne 7 years, what will it amount to, at 6 per cent. per annum, compound interest.

$$\frac{\overline{1,06\times1,06\times1,06\times1,06\times1,06\times1,06\times1,06-1,}\times250}{1,06-1}=$$

$2098,45cts. 9m.+ *Ans.*

2. If a salary, or an annuity, of £100 per annum, runs on unpaid for 6 years, at 5 per cent. compound interest, what is the amount due at the end of that period?

Ans. £680 3s. 9¾d. ,63.

CASE 2.—*To find the present worth of an annuity, &c.*

RULE.—Raise the amount of $1, or £1, at the given rate per cent. for 1 year, to that *power* denoted by the given number of years; divide the given annuity by this product; subtract its quotient from the given annuity; divide the remainder by the ratio made less by *unity* or 1; and the quotient will be the present worth sought.

EXAMPLES.

1. What is the present worth of a salary of $300, to continue 5 years, at 5 per cent. compound interest?

$$\frac{300}{1,05\times1,05\times1,05\times1,05\times1,05}=235,0578499405.+$$

$$\text{Then,}\ \frac{300-235,0578499405}{1,05-1,}=\overset{\$\ \ \text{c. m.}}{1298,84\ 3}+\textit{Ans.}$$

2. What is the present worth of £30 per annum, to continue 7 years, at 6 per cent. compound interest?

Ans. £167 9s. 5d.+

INVOLUTION.

INVOLUTION is the continual multiplication of a number into itself; and the products thence arising, with the original number itself, are called the powers of that number.

Any number may itself be called a *first power*. If the first power be multiplied by itself, the product is called the *second power*, or square: if the square be multiplied by the first power, the product is called the *third power*, or cube; if the cube be multiplied by the first power, the product is called the *fourth power*, or biquadrate, &c.

Thus 3 is the first power of 3.

3×3=9 is the second power of 3.

3×3×3=27 is the third power of 3.

3×3×3×3=81 is the fourth power of 3, &c. &c.

And in this manner is formed the following table of powers.

Table of the SQUARES and CUBES of the nine digits.

Roots.	1	2	3	4	5	6	7	8	9
Squares.	1	4	9	16	25	36	49	64	81
Cubes.	1	8	27	64	125	216	343	512	729

EXAMPLES.

1. What is the 6th power of 8?

```
     8 the root, or 1st power.
     8
    ---
    64=2d power, or square.
     8
   ----
   512=3d power, or cube.
     8
  -----
  4096=4th power, or biquadrate.
     8
 ------
 32768=5th power, or sursolid.
     8
-------
262144=6th power, or square cube.
```

Ans. 8^6.

NOTE.—The number denoting the height of the power, is called the index, or exponent of that power: so the 2d power of 3 may be denoted by 3^2, the 3d by 3^3, the 4th by 3^4, &c.; the 6th power of 8 by 8^6, &c.

2. What is the 7th power of $\frac{2}{3}$? Ans. $\frac{128}{2187}$.
3. What is the 5th power of $\frac{9}{6}$ or $1\frac{1}{2}$? Ans. $\frac{59049}{7776}$.
4. What is the fourth power of ,27? Ans. ,00531441.

EVOLUTION OR EXTRACTION OF ROOTS.

WHEN the root of any power is required, the business of finding it is called the extraction of the Root.

The root is that number, which by a continual multiplication into itself, produces the power which is given to be extracted.

Though every number will produce a perfect power by involution, yet there are many numbers, the precise roots of which can never be determined. By the help of decimals, however, we can approximate towards the root, to any assigned degree of exactness.

The roots which approximate, are called surd roots, and those which are perfectly accurate, are called rational roots.

TO EXTRACT THE SQUARE ROOT.

Any number multiplied into itself, produces a square. The extracting of the square root, is only finding a number, which, being multiplied into itself, shall produce the given number.

RULE.—1. Distinguish the given number into periods of two figures each, by putting a point over the place of units, another over the place of hundreds, and so on over every second figure; and if there be decimals, point them in the same manner, from units towards the right hand; which points show the number of figures the root will consist of.

2. Find by the table or trial the greatest square number in the first, or left hand period, place the root of it at the right hand of the given number, (after the manner of a quotient in division,) for the first figure of the root; and set the square number under the period, subtract it therefrom, and to the remainder bring down the next period for a dividend.

3. Place the double of the root already found on the left hand of the dividend for a divisor.

4. Consider what figure must be annexed to the divisor, so that if the result be multiplied by it the product may be equal to, or the next less than the dividend, and it will be the second figure of the root.

5. Subtract that product from the dividend, and to the remainder bring down the next period for a new dividend.

6. Find a divisor as before, by doubling the figures already in the root; and from these find the next figure of the root as in the last article; and so on through all the periods to the last.

Or, to facilitate the foregoing operation, when a period is brought down to a remainder, and a dividend thus formed, in order to find a new figure in the root, divide said dividend, (omitting the right hand figure thereof,) by double the root already found, and the quotient will commonly be the figure of the root sought, or, being made less by one, or two, will generally give the next figure sought.

TO EXTRACT THE SQUARE ROOT OF A VULGAR FRACTION.

First prepare all vulgar fractions by reducing them to their lowest terms, both for this and all other roots. Then,

1. Take the root of the numerator and that of the denominator for the respective terms of the root required; and this is the best way if the denominator be a complete power.. But if not,

2. Multiply the numerator and denominator together; take the root of the product; this root, being made the numerator to the denominator of the given fraction, or the denominator to the numerator of it, will form the fractional root required.

3. Or reduce the vulgar fraction to a decimal, and extract its root.

EXAMPLES.

1. Required the square root of 6749604.

```
     .  .  .  .
     6749604(2598
     4
     ----
  45)274
   5)225
  ---------
 509)4996
   9)4581
 -----------
5188)41504
   8)41504
 -----------
```

Ans. The root exactly without a remainder; but when the periods belonging to any given number are all exhausted, and still leave a remainder, the operation may be continued at pleasure, by annexing periods of ciphers, &c.—Roots are often denoted by writing √ before the power, with the index of the root within or over it, save the index of the square root, which is ever understood: so $\sqrt{64}$ is the 2d or square root of 64: $\sqrt[3]{64}$ the 3d or cube root of 64: $\sqrt[4]{64}$ the 4th root of 64.

2. Required the square root of 739,4.

```
      .  .  .
      739,40(27,19+root.
      4
      ----
   47)339
    7)329
  ---------
 541) 1040
   1)  541
 ----------
5429)49900
   9)48861
 ----------
      1039 remainder.
```

When the square root of a number is wanted to many places, the work may be much abridged. Find half the root by the rule; then to get the rest, annex to the last remainder as many ciphers as you need, and divide it by the double of the root before found.

3. What is the square root of 2? Ans. 1,41421356.+
4. " " 10842656? Ans. 3216.
5. " " $\sqrt{964,5192360241}$? Ans. 31,05671.
6. " " $\sqrt{,00032754}$? Ans. ,01809.+
7. " " $\sqrt{\frac{2783}{8208}}$? Ans. $\frac{7}{12}$.
8. " " $\sqrt{42\frac{1}{4}}$? Ans. $6\frac{1}{2}$.
9. " " $\sqrt{6\frac{2}{5}}$? Ans. 2,5298+&c.

APPLICATION AND USE OF THE SQUARE ROOT.

CASE 1.—*To find a mean proportional between any two given numbers.*

RULE.—Multiply the two given numbers together, and extract the square root of the product, which root will be the number sought.

EXAMPLE.

What is the mean proportional between 16 and 36?

$\sqrt{36\times16}=24$. Ans.

CASE 2.—*To find the side of a square equal in area to any given superficies.*

RULE.—Extract the square root of the given superficies, which root will be the side of the square sought.

EXAMPLES.

1. If an acre of land contains 160 square rods, what will be the side of a square, which should contain just an acre? $\sqrt{160}=12,649+$rods. Ans.

2. A general having an army of 5184 men, wishes to form them into a square; how many must he place in rank and file? $\sqrt{5184}=72$. Ans.

3. Let 8192 men be formed into an oblong, so that the number in rank may be double the file.

$\sqrt{\frac{8192}{2}}=64$ in file. $64\times2=128$ in rank.

4. Suppose a gentleman would set out an orchard of 864 trees, so that the length shall be to the breadth as 3 to 2, and the distance of each tree, one from the other, 7 yards; how many trees must there be in length, and how many in breadth, and how many square yards of ground do they stand on?

To resolve any question of this nature, say, as the ratio in length is to the ratio in breadth, so is the number of trees to a fourth number, whose square root is the number in breadth; then, as the ratio in breadth is to the ratio in length, so is the number of trees to a fourth number, whose root is the number in length. And, as unity is to the distance, so is the number in length, less by one, to a fourth number; next, do the same by the breadth, and multiply the two numbers thus found together, and the product will be the answer.

As 3 : 2 : : 864 : 576,& $\sqrt{576}=24$ num. in breadth. *Ans.*
As 2 : 3 : : 864 : 1296,& $\sqrt{1296}=36$ do. in length. *Ans.*
As 1 : 7 : : 36—1 : 245. And, as 1 : 7 : : 24—1 : 161.
And $245\times161=39445$ square yards. *Ans.*

Case 3.—*To ascertain the proportionate capacities of water pipes.*

Rule.—Square the given diameter, and multiply said square by the given proportion; the square root of the product is the answer.

EXAMPLE.

Admit 10hhds. of water are discharged through a leaden pipe of $2\frac{1}{2}$ inches diameter, in a certain time; what must be the diameter of another pipe, that shall discharge four times as much water in the same time?

$2\frac{1}{2}=2,5$ and $2,5\times2,5=6,25$ square.
4 given proportion.

$\sqrt{25,00}=5$ inches diameter. *Ans.*

Case 4.—*The sum of any two numbers, and their product being given, to find each number.*

Rule.—From the square of their sum, subtract 4 times their product, and extract the square root of the remain-

der, which will be the difference of the two numbers; then half the said difference added to half the sum, gives the greater of the two numbers, and the said half difference, subtracted from the half sum, gives the less number.

EXAMPLES.

1. The sum of two numbers is 46, and their product is 504; what are those two numbers?

The sum of the numbers 46×46=2116 sq. of their sum.
The product of ditto. 504×4=2016 four times the pro.

$\sqrt{100}$=10 dif. of the num.

46÷2=23 half sum. 10÷2=5 half differ.
+5 half difference. 23 half sum.
—5 half difference.
28 greater number. Ans.
18 less number. *Ans.*

2. Bought a certain quantity of broadcloth for $573, 75 cents; and if the number of cents which it cost per yard, was added to the number of yards bought, the sum would be 480; how many did I buy, and at what price per yard. Ans. 255yds. at $2,25cts. per yard.

3. If I lay out a lot of land in an oblong form, containing 7 acres, 1 rood, and 10 rods, and taking just 142 rods of wall to enclose it; pray how many rods long, and how many wide is said lot?

Ans. 45 rods long, and 26 rods wide.

CASE 5.—*To find the degree of light, heat, or attraction.*

NOTE.—The effects or degrees of light, heat, and attraction, are in proportion to the squares of the distances, whence they are propagated.

EXAMPLES.

1. Two men, A and B. are sitting in a room, the former 3, and the latter 6 feet distant from a fire; how much hotter is it at A's than at B's seat?

3×3=9, & 6×6=36. Then, as 9 : 1 : : 36 : 4, so that A's place is 4 times as hot as B's. *Ans.*

2. If the earth's mean distance from the sun be 95,000,000 of miles, at what distance from him must another

body be placed, that it may receive a degree of light and heat, double to that of the earth?

$$\sqrt{\frac{95\,000000^2}{2}} = 67175144+\text{mile.}$$ *Ans.* which is somewhat less than the distance of Venus from the sun.

3. A ball descending by the force of gravity from the top of a tower, was observed to fall half the way in the last second of time; how long was it in descending, and what was the height of the tower?

The square roots of the distances are as the times, viz. As the $\sqrt{1} : \sqrt{2} : :$ the time of falling through to the whole required height.

Now, the $\sqrt{1}=1$, and $\sqrt{2}=1{,}4142$, from which take 1; ,4142 remains.

And, as ,4142 : 1,4142 : : 1 : 3,414+sec. time of descent; the square of which is 11,6554 nearly. And the velocity acquired by heavy bodies falling near the surface of the earth, is 16 feet in the first second, 64 in the second second, 144 in the third second, &c., that is, the space fallen through [in feet] is always equal to the square of the time in 4ths of a second.

As 1^2 : *ft.* 16 : : *sec. sq.* 11,6554 : 186,4864 = 186½ feet nearly, height of the tower. *Ans.*

Case 6.—*Any two sides of a right-angled triangle given, to find the other side.*

Rule.—Extract the square root of the sum of the squares of the two least sides, and that root is the greatest side; for the square root of the sum of the squares of the two legs, is always the length of the hypotenuse. Extract the square root of the difference of the squares of either of the two least sides and the greatest side, and that root is the other side; for the square root of the difference of the squares of either leg and the hypotenuse, is always the length of the other leg.

EXAMPLES.

1. A ladder 40 feet long may be so planted as to reach a window 33 feet from the ground, on one side of the street; and without moving it at the foot, will do the same by a window 21 feet high on the other side; how wide is the street?

$40^2=1600$. $33^2=1089$. $21^2=441$. Then $1600-1089$

$=511$ and $\sqrt{511}=22,6$; and $1600-441=1159$, and $\sqrt{1159}=34,04$; then $22,6+34,04=54,64$ feet.+ *Ans.*

2. A line 27 yards long will exactly reach from the top of a fort to the opposite bank of a river, known to be 23 yards broad; what is the height of the wall?

Ans. 14,142+yards.

3. Two ships sail from the same port; one sails due east 50 leagues, and the other due north 84 leagues; how far are they then apart? Ans. 97,75+leagues.

TO EXTRACT THE CUBE ROOT.

A cube is any number multiplied by its *square.*

To extract the Cube Root, is to find a number which, being multiplied into its square, shall produce the given number.

Rule.—1. Separate the given number into periods of three figures each, by putting a point over the unit figure, and every third figure both ways from the place of units.

2. Find the nearest less cube to the first period by the table of powers or trial; set its root in the quotient; subtract the cube found from the first period, and to the remainder bring down the second period, and call this the resolvend.

3. To three times the square of the root just found, add three times the root itself, setting this one place more to the right than the former, and call this sum the *divisor.* Then divide the resolvend, omitting the unit figure, by the divisor, for the next figure of the root, which annex to the former, calling this last figure *e*, and the part of the root before found, call *a*.

4. Add together these three products, viz. thrice the square of *a* multiplied by *e*, thrice *a* multiplied by the square of *e*, and the cube of *e*, setting each of them one place more to the right hand than the former, and call the sum the *subtrahend*, which must not exceed the resolvend; but if it do, then make the last figure *e* less, and repeat the operation for finding the subtrahend.

5. From the resolvend take the subtrahend, and to the remainder join the next period of the given number for a

new resolvend; to which form a new divisor from the whole root now found, and thence another figure of the root as before, &c.

EXAMPLES.

1. Required the cube root of 48228,544.

$3\times3^3=27$ | 48228,544(36,4 root.
$3\times3=09$ | 27

Divisor 279 | 21228 resolvend.

$3\times3^2\times6=162$
$3\times3\times6^2=324$ } Add.
$6^3=216$

$3\times36^2=3888$ | 19656 subtrahend.
$3\times36=108$

Divisor 38988 | 1572544 resolvend.

$3\times36^2\times4=15552$
$3\times36\times4^2=1728$ } Add.
$4^3=64$

1572544 subtrahend.

2. What is the cube root of 1092727? Ans. 103.
3. What is $\sqrt[3]{34965783}$? Ans. 327.
4. What is $\sqrt[3]{,0001357}$? Ans. ,05138.+
5. What is $\sqrt[3]{\frac{1520}{5130}}$ Ans. $\frac{2}{3}$.
6. What is $\sqrt[3]{\frac{2}{3}}$? Ans. ,873+
7. What is $\sqrt[3]{2}$? Ans. 1,25.+
8. What is $\sqrt[3]{\frac{512}{729}}$ Ans. $\frac{8}{9}$

APPLICATION AND USE OF THE CUBE ROOT.

EXAMPLES.

1. The statute bushel contains 2150,4197+ cubic or solid inches; I demand the side of a cubic box which shall contain just that quantity?

$\sqrt[3]{2150,419724}=12,907+$inch. Ans.

NOTE.—The solid contents of similar figures, are in proportion to each other, as the cubes of their similar sides or diameters.

2. If a bullet 4 inches diameter weigh 9lb., what will a bullet of the same metal weigh, whose diameter is 8 inches? $4\times4\times4=64$. $8\times8\times8=512$. As 64 : 9 : : 512 : 72lb. Ans.

3. If a solid globe of silver, of 3 inches diameter, be worth \$150, what is the value of another globe of silver, whose diameter is eight inches?

$3\times3\times3=27$. $8\times8\times8=512$. As 27 : \$150 : : 512 : \$2844$\frac{12}{27}$ Ans.

The side of a cube being given, to find the side of that cube which shall be double, triple, &c. in quantity to the given cube.

RULE.—Cube the given side, and multiply it by the given proportion between the given and required cube, and the cube root of the product will be the side sought.

4. If a cube of silver, whose side is 2 inches, be worth \$20, what should the side of a cube of like silver be, whose value would be 8 times as much?

$2\times2\times2=8$, and $8\times8=64$. $\sqrt[3]{64}=4$ inches. *Ans.*

5. There is a cubical vessel whose side is 4 feet; I demand the side of another cubical vessel, which shall contain 4 times as much?

$4\times4\times4=64$, & $64\times4=256$. $\sqrt[3]{256}=6,349+$ feet. Ans.

6. A cooper having a cask 40 inches long, and 32 inches at the bung diameter, is ordered to make another cask of the same shape, but which shall hold just twice as much; what will be the bung diameter, and length of the new cask?

$40\times40\times40\times2=128000$; then $\sqrt[3]{128000}=50,3+$ inches length. *Ans.*

$32\times32\times32\times2=65536$; & $\sqrt[3]{65536}=40,3+$ inches bung diam. Ans.

TO EXTRACT THE ROOTS OF POWERS IN GENERAL.

RULE.—1. Prepare the given number for extraction by pointing off from the place of units as the root required directs; 4th root put a dot over every 4th figure &c. from the place of units; 5th root, over every 5th, &c. from units' place, &c.

2. Find the first figure of the root by trial, and subtract its power from the given number.

3. To the remainder bring down the first figure in the next period, and call it the *dividend.*

4. Involve the root to the next inferiour power to that which is given, and multiply it by the number denoting the given power, for a *divisor.*

5. Find how many times the divisor may be had in the dividend, and the quotient will be another figure of the root.

6. Involve the whole root to the given power, and subtract it from the given number as before.

7. Bring down the first figure of the next period to the remainder for a new dividend, to which find a new divisor, and so on, until the whole is finished.

EXAMPLES.

1. What is the cube root of 53157376?

$$\dot{5}31\dot{5}7\dot{3}76(376 \text{ root.}$$
$$27=3^3$$
$$3^2\times3=27)261 \text{ dividend.}$$
$$50653=37^3$$
$$37^2\times3=4107)25043 \text{ second dividend.}$$
$$53157376=376^3$$

2. What is the biquadrate root of 34827998976?

Ans. 431,9.+

3. What is the sursolid root of 281950621875?

Ans. 195.

4. What is the square cubed, or sixth root of 16196,005304079729? Ans. 5,03.

5. Find the seventh root of 34487717467,30751.

Ans. 32,01.+

NOTE.—The roots of most powers may be found by the square and cube roots only; therefore, when any even power is given, the better way will be, especially in very high powers, to extract the square root of it, which reduces it to half the given power, then the square root of that power; and so on till it comes to a square or cube.

For example, suppose a 12th power be given; the square root of that reduces it to a sixth power; and the square root of a sixth power to a cube.

6. Extract the eighth root of 7213895789838336.
Ans. 96.

7. What is the biquadrate root of 5308416? *Ans.* 48.

ARITHMETICAL PROGRESSION.

Any rank of numbers more than two increasing by a common excess, or decreasing by a common difference, is said to be in *Arithmetical Progression:* such are the numbers 1, 2, 3, 4, &c. 7, 5, 3, 1; and ,8, ,6, ,4, ,2. When the numbers increase, they form an *ascending series;* but when they decrease, they form a *descending series.*

The numbers which form the series, are called the *terms* of the progression.

Any *three* of the five following terms being given, the other two may readily be found.

1st. The first term, }
2d. The last term, } commonly called the *extremes.*
3d. The number of terms.
4th. The common difference.
5th. The sum of all the terms.

Problem 1.

The first term, the last term and the number of terms being given, to find the sum of all the terms.

Rule.—Multiply the sum of the extremes by the number of terms, and half the product will be the answer.

EXAMPLES.

1. The first term of an arithmetical progression is 1, the last term 21, the number of terms 11; required the sum of the series.

$$\begin{array}{r} 21 \\ 1 \\ \hline 22 \\ 11 \\ \hline 2)242 \\ \hline Ans.\ 121 \end{array} \quad \text{Or} \quad \frac{\overline{21+1}\times 11}{2} = 121 \text{ the } Ans.$$

2. How many strokes does a Venice clock strike in the compass of a day, going to 24 o'clock? Ans. 300.

3. If 100 stones be placed in a right line, a yard distant from each other, and the first a yard from a basket; what distance will that man go who gathers them up singly, returning with them one by one to the basket?

Ans. 5 miles and 1300 yards.

4. A draper sold 100 yards of cloth at 5cts. for the first yard, 10cts. for the second, 15 for the third, &c., increasing 5cts. for every yard; what did the whole amount to, and what did it average per yard?

Ans. Amount was $\$252\frac{1}{2}$, and the average price was $2,52cts. 5m. per yard.

Problem II.

The extremes and the number of terms being given, to find the common difference.

Rule.—Divide the difference of the extremes by the number of terms less 1, and the quotient will be the common difference.

EXAMPLES.

1. The extremes are 3 and 19, and the number of terms is 9; required the common difference, and the sum of the whole series.

$$\begin{array}{rr} 9 & 19 \\ 1 & 3 \\ \hline 8) & 16 \\ \hline & 2 \end{array} \quad \text{And } \frac{\overline{19+3}\times 9}{2} = 99 \text{ the sum.}$$

2 difference.

2. A man is to travel from Boston to a certain place in 12 days, and to go but three miles the first day increasing every day by an equal excess, so that the last day's journey may be 58 miles; required the daily increase, and the distance of the place from Boston.

Ans. Daily increase 5, distance 366 miles.

3. A man had 12 sons whose several ages differed alike; the eldest was 49, the youngest 5 years old; what was the common difference of their ages? *Ans.* 4 years.

PROBLEM III.

Given the first term, the last term, and the common difference, to find the number of terms.

RULE.—Divide the difference of the extremes by the common difference, and the quotient increased by 1, is the number of terms required.

EXAMPLES.

1. The extremes are 3 and 19, and the common difference 2; what is the number of terms?

$$\begin{array}{r} 19 \\ 3 \\ \hline 2)16 \\ \hline 8 \\ 1 \\ \hline \text{Ans. } 9 \end{array} \quad \text{Or } \frac{19-3}{2}+1=9 \text{ the answer.}$$

2. Suppose a man travel the first day 7 miles, the last 51 miles, and increase his journey each day by 4 miles; how many days will he travel, and how far?

Ans. 12 days, and 348 miles.

GEOMETRICAL PROGRESSION.

ANY series of numbers, the terms of which gradually increase or decrease by a constant multiplication or division, are said to be in *Geometrical Progression.* Thus, 4, 8, 16, 32, 64, &c. and 81, 27, 9, 3, 1, &c. are series in geometrical progression, the one increasing by a constant multiplication by 2, and the other decreasing by a constant division by 3.

The number by which the series is constantly increased or diminished, is called the ratio.

PROBLEM I.

Given the first term, the last term, and the ratio, to find the sum of the series.

RULE.—Multiply the last term by the ratio, and from the product subtract the first term, and the remainder divided by the ratio less 1, will give the sum of the series.

EXAMPLES.

1. The extremes of a geometrical progression are 1 and 65536, and the ratio 4; what is the sum of the series?

```
        65536
            4
       ------           -----------
       262144           4×65536—1
            1       Or  ----------- =87381 Ans.
       ------              4—1
4—1=3)262143
       ------
        87381 Ans.
```

2. A man travelled 6 days; the first day he went 4 miles, and doubling his travel each day, his last day's ride was 128 miles; how far did he go in the whole?

Ans. 252 miles.

3. The extremes of a geometrical series are 1024 and 59049, and the ratio is $1\frac{1}{2}$; what is the sum of the series?

Ans. 175099.

Problem II.

*Given the first term and the ratio, to find any other term assigned.**

Case I.—*When the first term of the series, and the ratio are equal.†*

Rule 1.—Write down a few of the leading terms of the series, and place their indices over them, beginning the indices with a unit or 1.

2. Add together such indices as, in their sum shall make up the entire index to the term required.

* As the last term in a long series of numbers is very tedious to be found by continual multiplication, it will be necessary for more readily finding it out, to have a series of numbers in arithmetical proportion, called indices, whose common difference is 1.

† When the first term of the series, and the ratio are equal, the indices must begin with a unit, and in this case, the product of any two terms is equal to that term, signified by the sum of their indices.

Thus: { 1, 2, 3, 4, 5, &c. Indices or arithmetical series.
{ 2, 4, 8, 16, 32, &c. Geometrical series.

Now, 2+3=5, the index of the fifth term, and 4×8=32=the fifth term.

3. Multiply together the terms of the geometrical series belonging to those indices, and the product will be the term required.

EXAMPLES.

1. The first term of a geometrical series is 2, and the ratio 2; required the 13th term.

1, 2, 3, 4, 5, 6, 7, indices.
2, 4, 8, 16, 32, 64, 128, leading terms.

Then $6+7=$index to the 13th term.
And $64\times128=8192$ the answer.

2. A young man agreed with a farmer to work for him 11 years, with no other reward than the produce of one grain of wheat for the first year, allowing the increase to be tenfold, and that produce to be sowed the second year, and so on from year to year, until the end of the time; what is the sum of the whole produce, allowing 7680 grains to make a pint, and what does it amount to, at one dollar and fifty cents per bushel?

Ans. $226056\frac{1}{8}+$bush., and \$339084,19cts.+

NOTE.—In such questions, you first find the last term by one of the cases in Problem 2, and then the sum of the whole series by Problem 1.

3. A rich miser thought 20 guineas apiece too much for 12 fine horses, but readily agreed to give 4 cents for the first, 16 cents for the second, 64 cents for the third horse, and so on, in fourfold proportion, to the last;—what did they come to, at that rate, and how much did they cost per head, one with another?

Ans. { The 12 horses came to \$223696,20cts. and the average price was \$18641,35cts. per head.

CASE 2.—*When the first term in the series, and the ratio, are different; that is, when the first term is either greater or less than the ratio.**

RULE.—1 Write down a few of the leading terms of the series, as before, and begin their indices with a cipher; thus:—0, 1, 2, 3, &c.

* When the first term of the series and the ratio are different, the indices must begin with a cipher, and the sum of the indices made choice of, must be one less than the number of terms given in the question; because 1 in the indices stands over the second term, and 2 in the indices, over the third term, &c.; and in this case, the pro-

2. Add together the most convenient indices to make an index, less by 1, than the number expressing the place of the term sought.

3. Multiply the terms of the geometrical series together, belonging to those indices, and make the product a dividend.

4. Raise the first term to a power whose index is one less than the number of terms multiplied, and make the result a divisor.

5. Divide the said dividend by the said divisor, and the quotient is the term required.

NOTE.—If the first term of any series be unity, or 1, the term required is found by multiplying the terms of the geometrical series together, which belong to those indices, without needing any division.

EXAMPLES.

1. Required the 12th term of a geometrical series, whose first term is 3, and ratio 2.

0, 1, 2, 3, 4, 5, 6, indices.
3, 6, 12, 24, 48, 96, 192, leading terms.
Then, $6+5=$index to the 12th term.
And $192\times96=18432=$dividend.

The number of terms multiplied is 2, and $2-1=1$, is the power to which the term 3 is to be raised; but the first power of 3 is 3=divisor; therefore

$18432\div3=6144$, the 12th term.

2. A goldsmith sold 1 ℔. of gold, at 2cts. for the first ounce, 8cts. for the second, 32cts. for the third, &c., in quadruple proportion geometrical; what did the whole come to? Ans. $111848,10cts.

3. A man bought a horse, and by agreement was to give a farthing for the first nail, two for the second, four for the third, &c. There were four shoes, and eight nails in each shoe;—What did the horse come to, at that rate? *Ans.* £4473924 5s. 3d. 3qrs.

duct of any two terms, divided by the first term, is equal to that term, beyond the first, signified by the sum of their indices.

$$\text{Thus}: \begin{cases} 0, & 1, & 2, & 3, & 4, & \text{\&c. indices.} \\ 1, & 3, & 9, & 27, & 81, & \text{\&c. geometrical series.} \end{cases}$$

Here $4+3=7$, the index of the 8th term.
$81\times27=2187$, the 8th term, or 7th beyond the 1st.

4. Suppose a certain body, put in motion, should move the length of one barleycorn the first second of time, one inch the second, three inches the third second of time, and so continue to increase its motion in triple proportion geometrical; how many yards would the said body move in the space of half a minute?

Ans. 953199685623yds. 1ft. 1in. 1bar.; which is no less than five hundred and forty one millions of miles.

ALLIGATION.

Alligation teaches to mix several simples of different qualities, so that the composition may be of a middle quality; and is commonly distinguished into two principal cases, called *Alligation Medial* and *Alligation Alternate.*

ALLIGATION MEDIAL.

Alligation Medial is the method of finding the rate of the compound, from having the rates, and quantities of the several simples given.

Rule.—Multiply each quantity by its rate; then divide the sum of the products by the sum of the quantities, or the whole composition, and the quotient will be the rate of the compound required.

EXAMPLES.

1. Suppose 20 bushels of wheat, at 10s. per bushel, 36 bushels of rye, at 6s. per bushel, and 40 bushels of barley, at 4s. per bushel, were mixed together; what would a bushel of this mixture be worth?

$$\begin{array}{rl} 20\times10= & 200 \\ 36\times\ 6= & 216 \\ 40\times\ 4= & 160 \\ \hline 96 &)576(6s.\ \textit{Answer.} \\ & 576 \end{array}$$

2. A composition being made of 5 pounds of tea, at 7s. per pound, 9 pounds, at 8s. 6d. per pound, and 14½ pounds, at 6s. 10½d. per pound; what is a pound of it worth?

Ans. 7s. 4¾d.+

3. A goldsmith mixes 8 pounds 5½ ounces of gold of 14 carats fine, with 12 pounds, 8½ ounces, of 18; what is the fineness of this mixture? Ans. 16$\frac{51}{127}$ carats.

4. If with 40 bushels of corn, at 4s. per bushel, there are mixed 10 bushels, at 6s. per bushel, 30 bushels, at 5s. per bushel, and 20 bushels, at 3s. per bushel; what will 10 bushels of that mixture be worth? Ans. \$7, 16⅔cts.

5. A grocer would mix 12cwt. of sugar, at 10 dollars per cwt. with 3cwt. at 8⅔ dollars per cwt. and 8cwt. at 7½ dollars per cwt.; what will a cwt. of this mixture be worth?

Ans. \$8,95cts. 6 mills.+

6. If 16 gallons of brandy at 1 dollar 25 cents, and 4 gallons of water, be mixed with 40 gallons of wine, at 3 dollars per gallon, what will the mixture be worth per gallon? Ans. \$2, 33⅓cts.

ALLIGATION ALTERNATE.

ALLIGATION ALTERNATE is the method of finding what quantity of any number of simples whose rates are given, will compose a mixture of a given rate; so that it is the reverse of alligation medial, and may be proved by it.

RULE.—Write the rates of the simples in a column under each other.

Connect, or link with a continued line, the rate of each simple, which is less than that of the compound, with one or any number of those, that are greater than the compound; and each greater rate with one or any number of the less.

Write the difference between the mixture rate, and that of each of the simple, opposite to the rates, with which they are respectively linked.

Then, if only one difference stand against any rate, it will be the quantity belonging to that rate; but if there be several, their sum will be the quantity.

EXAMPLES.

1. A merchant would mix wines, at 14s. 15s. 19s. and 22s. per gallon, so that the mixture may be worth 18s. per gall.; what quantity of each must be taken?

		s.				Or thus;—
18	14	4 at 14	Ans.	18	14	1 . . . . at 14s.
	15	1 at 15			15	1+4=5 at 15s.
	19	3 at 19			19	3+4=7 at 19s.
	22	4 at 22			22	3 . . . . at 22s.

2. How much corn at 2s. 6d. 3s. 8d. 4s. and 4s. 8d. per bushel, must be mixed together, that the compound may be worth 3s. 10d. per bushel?

Ans. 12 at 2s. 6d. 12 at 3s. 8d. 18 at 4s. & 18 at 4s. 8d.

3. A goldsmith has gold of 18 carats fine, 16, 19, 22 and 24; how much must he take of each to make it 21 carats fine? Ans. 3oz. of 16, 1oz. of 18, 1 oz. of 19, 5oz. of 22, and 5oz. of 24 carats fine.

4. It is required to mix brandy at 80 cents, wine at 70 cents, cider at 10cts. and water together, so that the mixture may be worth 50cts. per gallon.

Ans. 9gals. of brandy, 9 of wine, 5 of cider & 5 of water.

CASE 2.—*When the whole composition is limited to a certain quantity.*

RULE.—Find an answer as before by linking; then say, as the sum of the quantities, or differences thus determined is to the given quantity, so is each ingredient found, to the required quantity of each.

EXAMPLES.

1. How many gallons of water at 0cts. per gallon, must be mixed with wine worth 60cts. per gallon so as to fill a cask of 100 gallons, and that a gallon may be afforded at 50 cts.?

$$50\left\{\begin{matrix}0\\60\end{matrix}\right\}\begin{matrix}10\\50\end{matrix}$$

60 : 100 : : 10 : 60 : 100 : : 50 :

10 50

6,0)100,0 6,0)500,0

$16\frac{2}{3}$ $83\frac{1}{3}$

Ans. $16\frac{2}{3}$ gallons of water, and $83\frac{1}{3}$ of wine.

2. How much gold of 15, of 17, of 18 and 22 carats fine, must be mixed together to form a composition of 40 ounces of 20 carats fine?

Ans. 5oz. of 15, 17 and 18, and 25oz. of 22.

3. Brandy at 3s. 6d. and at 5s. 9d. per gallon, is to be mixed, so that a hogshead of 63 gallons may be sold for £12 12s.; how many gallons must be taken of each?

Ans. 14gals. at 5s. 9d. and 49gals. at 3s. 6d.

CASE 3.—*When one of the ingredients is limited to a certain quantity.*

RULE.—Take the difference between each price and the mean rate as before; then, as the difference of that simple whose quantity is given, is to the rest of the differences severally, so is the quantity given to the several quantities required.

EXAMPLES.

1. A grocer would mix teas at 1 dollar 20cts. 66cts. and 1 dollar per pound, with 20 pounds at 40 cents per pound; how much of each sort must he take to make the composition worth 80 cents per pound?

$$80\left\{\begin{array}{r}40\\66\\100\\120\end{array}\right.\left|\begin{array}{r}40\\20\\14\\40\end{array}\right.\quad\begin{array}{l}\text{℔}\quad\text{℔}\quad\text{℔}\quad\text{℔}\\ \\ 40:20::20:10 \text{ at } 66\text{cts.}\\ 40:14::20:\ \ 7 \text{ at } \$1\\ 40:40::20:20 \text{ at } \ 1,20\end{array}\left.\right\}\text{Ans.}$$

2. How much wine at 80cts. at 88 and 92 per gallon, must be mixed with 4 gallons at 75cts. per gallon, so that the mixture may be worth 86 cents per gallon?

Ans. 4gals. at 80cts. $8\frac{1}{2}$ at 88 and $8\frac{1}{2}$ at 92.

3. With 95 gallons of rum at 8s. per gallon, I mixed other rum at 6s. 8d. per gallon, and some water; then I found it stood me in 6s. 4d. per gallon;—I demand how much rum at 6s. 8d. I took, and how much water.

Ans. 95 gallons rum at 6s. 8d. and 30 gallons water.

POSITION.

POSITION is a method of performing such questions as cannot be resolved by the common direct rules, and is of two kinds, *Single* and *Double*.

SINGLE POSITION.

Single Position teaches to resolve those questions whose results are proportioned to their suppositions.

RULE.—1. Take any number and perform the same operations with it, as are described to be performed in the question.

2. Then say, as the result of the operation is to the position, so is the result in the question to the number required.

EXAMPLES.

1. A's age is double that of B, and B's is triple that of C, and the sum of all their ages is 140; what is the age of each? Suppose A's age to be 48

Then will B's $=\frac{48}{2}=24$

And C's $=\frac{24}{3}=8$

80 sum.

As 80 : 48 : : 140 : 84 = A's age.

Consequently $\frac{84}{2}=42=$ B's.

And $\frac{42}{3}=14=$ C's.

140 Proof.

2. A certain sum of money is to be divided between 4 persons in such a manner that the first shall have $\frac{1}{3}$ of it, the second $\frac{1}{4}$, the third $\frac{1}{6}$, and the fourth the remainder, which is 28 dollars; what is the sum? *Ans.* \$112.

3. A person, after spending $\frac{1}{3}$ and $\frac{1}{4}$ of his money, had 60 dollars left; what had he at first? *Ans.* \$144.

4. What number is that which being increased by $\frac{1}{2}$, $\frac{1}{3}$ and $\frac{1}{4}$ of itself, the sum will be 125? *Ans.* 60.

5. A person lent his friend a sum of money, to receive interest for the same at 6 per cent. per annum, simple interest; at the end of three years he received for principal and interest 383 dollars 50 cents; what was the sum lent? *Ans.* 325 dollars.

6. A cistern is supplied with three cocks, A, B, and C: A can fill it in 1 hour, B in 2, and C in 3; in what time will it be filled by all of them together? *Ans.* $\frac{6}{11}$ hour.

DOUBLE POSITION.

Double Position teaches to resolve questions by making two suppositions of false numbers.*

* Questions in which the results are not proportional to their positions, belong to this rule; such are those, in which the number sought is increased or diminished by some given number, which is no known part of the number required.

RULE 1.—Take any two convenient numbers, and proceed with each according to the conditions of the question.

2. Find how much the results are different from the result in the question.

3. Multiply each of the errours by the contrary supposition.

4. If the errours be alike, divide the difference of the products by the difference of the errours, and the quotient will be the answer.

5. If the errours be unlike, divide the sum of the products by the sum of the errours, and the quotient will be the answer.

NOTE.—The errours are said to be *alike*, when they are both too great, or both too little; and *unlike*, when one is too great, and the other too little.

EXAMPLES.

1. A lady bought cambric for 40 cents a yard, and India cotton at 20 cents a yard; the whole number of yards she bought was 8, and the whole cost 2 dollars; how many yards had she of each sort?

Suppose 4 yards of cambric, value $1,60 cts.
Then she must have 4 yards of cotton, value 80

Sum of their values, 2,40
So that the first errour is +40
Again, suppose she had 3 yards of cambric, $1,20 cts.
Then she must have 5 yards of India cotton, 1,00

Sum of their values, 2,20
So that the second errour is +20
Then 40—20=20=difference of the errours.
Also 4×20=80=product of the first supposition and second errour.
And 3×40=120=product of the second supposition and first errour.
And 120—80=40=their difference.
Whence 40÷20=2 yards of cambric, } Ans.
And 8—2=6 yards of India cotton }

2. A and B have both the same income; A saves $\frac{1}{5}$ of his yearly; but B, spending 50 dollars a year more than

A, at the end of 4 years is 100 dollars in debt; what is their income, and what do they spend per annum?

Ans. Their income is \$125 per year. A spends \$100. B spends \$150.

3. A laborer was hired for 40 days upon these conditions, that he should receive 2 dollars for every day he wrought, and forfeit 1 dollar for every day he was idle; at the expiration of the time he was entitled to 50 dollars; how many days did he work, and how many was he idle?

Ans. He wrought 30 days and was idle 10.

4. A man had 2 silver cups of unequal weight, with 1 cover for both, weight 5oz.; now if he put the cover on the less cup, it will be double the weight of the greater; and put on the greater cup, it will be three times the weight of the less cup; what is the weight of each cup?

Ans. 3oz. the less, and 4oz. the greater.

5. A person being asked what o'clock it was, answered that the time past from noon was equal to $\frac{2}{13}$ of the time to midnight; required the time.

Ans. 36 minutes past 1.

6. There is a fish whose head is ten feet long; his tail is as long as his head and half the length of his body, and his body is as long as his head and tail; what is the whole length of the fish? *Ans.* 80 feet.

7. A and B laid out equal sums of money in trade; A gained a sum equal to $\frac{1}{4}$ of his stock, and B lost 225 dollars; then A's money was double that of B's; what did each lay out? Ans. \$600.

PERMUTATION AND COMBINATION.

The permutation of quantities is the showing how many different ways the order or position of any given number of things may be changed.

The combination of quantities is the showing how often a less number of things may be taken out of a greater, and combined together, without considering their places, or the order in which they stand.

PROBLEM I.

To find the number of permutations, or changes, that can be made of any number of things, all differing from each other.

RULE.—Multiply all the terms of the natural series of numbers, from one up to the given number, continually together, and the last product will be the answer.

EXAMPLES.

1. How many changes may be made with these three letters, A, B, C.

	CHANGES.	
1	a b c 1	Proof.
2	a c b 2	
—	b a c 3	
2	b c a 4	
3	c a b 5	
—	c b a 6	
6 Answer		

2. How many changes may be rung upon 6 bells?

Ans. 720.

3. How many changes may be rung upon 12 bells, and how long would they be ringing but once over, supposing 10 changes might be rung in one minute, and that the year contains 365 days, 6 hours?

Ans. { 479001600 changes, and 91 years 3w. 5d. and 6 hours.

4. A young scholar coming into a town for the convenience of a good library, demanded of the gentleman with whom he lodged, what his diet would cost for a year; he told him \$150; but the scholar not being certain what time he should stay, asked him what he should give him for so long as he could place his family (consisting of 6 persons beside himself) in different positions every day at dinner; the gentleman told him \$50; to this the scholar agreed—what time did he stay? Ans. 5040 days.

PROBLEM II.

Any number of different things being given, to find how many changes can be made out of them, by taking any given number at a time.

Rule.—Take a series of numbers, beginning at the number of things given, and decreasing by one, till the number of terms be equal to the number of things to be taken at a time, multiply these terms into each other; and the product will be the answer.

EXAMPLES.

1. How many changes may be made out of the three letters a, b, c, by taking two at a time?

	CHANGES.		
3	a b	1	Proof.
2	b a	2	
–	a c	3	
6 Answer.	c a	4	
	b c	5	
	c b	6	

2. How many changes may be made with the nine digits, by taking 3 at a time? Ans. 504.

3. How many words may be made with the alphabet by taking five letters at a time, supposing that a number of consonants may make a word? Ans. 5100480.

Problem III.

To find the compositions of any number, in an equal number of sets, the things themselves being all different.

Rule.—Multiply the number of things in every set continually together, and the product will be the answer.

EXAMPLES.

1. Suppose there are four companies, in each of which there are nine men; it is required to find how many ways four men may be chosen, one out of each company.

$9\times9\times9\times9=6561$ the answer.

2. How many changes are there in throwing five dice? Ans. 7776.

3. Suppose there are four companies, in one of which there are 6 men, in another 8, and in each of the other two, 9; what are the choices by a composition of four men, one out of each company? Ans. 3888.

4. Suppose a man undertakes to throw an ace, at one throw, with 4 dice; what is the probability of his effecting it? Ans. as 671 to 625.

MISCELLANEOUS QUESTIONS.

1. A gentleman bought 27 yards of cloth at 2s. per yard, 24 yards at 3s. 1½d. per yard, 25 yards at 1s. 8½d. per yard; he also bought 3 yards of broadcloth, the price of which he does not recollect; but on counting his money he found he had expended £11 19s. 2½d.; what did his broadcloth cost per yard, in Federal Money?

Ans. $3,75cts.

2. A servant went to market with £5, and bought eggs at 7 for 4d.; 2 pair of fowls at 2s. 4d. a pair; 17 pigeons at 3s. per dozen; 3 rabbits at 14d. each; and 3 dozen of larks at 14d. per dozen; he also paid the baker £2 17s. 1d.; when he returned he had 21s. left; how many eggs did he buy? *Ans.* 126.

3. I have a drawer 17 inches long, 12 inches broad and 7 inches deep; how many one inch dice will it hold?

Ans. 1428.

4. At a certain election 375 persons voted, and the candidate chosen had a majority of 91; how many voted for each? *Ans.* 233 and 142.

5. Suppose a man to step 30 inches at a time, and to go 4 miles an hour; how many times does he step in a minute? *Ans.* 140⅘.

6. The divisor is 43967, the quotient 2737226, and the remainder 27672; what is the dividend?

Ans. 120347643214.

7. A prize of $1000 is to be divided between two persons whose shares are in proportion of 7 to 9; required the share of each. *Ans.* { $437,50cts. / $562,50cts.

8. After paying away ¼ and ⅕ of my money, I had 66 guineas left in my purse; what was in it at first?

Ans. 120.

9. A reservoir for water has two cocks to supply it; the first alone will fill it in 40 minutes, the second in 50 minutes and it has a discharging cock by which it may be emptied, when full, in 25 minutes. Now supposing that these three cocks are all opened, that the water comes in, and that the influx and the efflux of the water are always alike, in what time would the cistern be filled?

Ans. 3 hours, 20 minutes.

10. In the latitude of Hallowell, a degree of longitude measures about 49 miles, 6 furlongs, and $11\frac{1}{5}$ poles; now as the earth turns round in about 23 hours, 56 minutes, at what rate per hour is the town of Hallowell carried by this motion from west to east?* *Ans.* $748\frac{8}{3}\frac{9}{5}\frac{7}{9}$ miles.

11. If the earth turns round in 23 hours 56 minutes, at what rate per hour are the inhabitants of the city of Quito, in South America, which lies under the equator, carried from west to east by this rotation? *Ans.* $1015\frac{1}{3}\frac{4}{5}\frac{5}{9}$ miles.

12. In a mixture of wine cider, $\frac{1}{2}$ of the whole added to 25 gallons, was wine; and $\frac{1}{3}$ part, less 5 gallons, was cider; how many gallons were there of each?

Ans. 85 of wine and 35 of cider.

13. A hare is 50 of her own leaps before a greyhound, and takes 4 leaps to the greyhound's 3; but two of the greyhound's leaps are as much as 3 of the hare's; how many leaps must the greyhound take to catch the hare?

Ans. 300.

14. Out of a cask of wine which had leaked away $\frac{1}{3}$ part, 21 gallons were drawn; and then being guaged, it was found to be half full; how many gallons did it hold?

Ans. 126.

15. What part of 4d. is $\frac{4}{5}$ of 6 pence? *Ans.* $\frac{6}{5}$.

16. What number is that from which, if 5 be subtracted $\frac{2}{3}$ of the remainder is 80? *Ans.* 125.

17. A post is $\frac{1}{4}$ in the mud, $\frac{1}{3}$ in the water, and 10 feet above the water; what is its whole length? *Ans.* 24.

18. A captain, mate, and 20 seamen, took a prize worth \$3501; of which the captain takes 11 shares, and the mate 5 shares; the remainder of the prize is equally divided among the sailors; how much did each man receive? *Ans* { The Capt. \$1069,75cts.—The mate \$486,25cts. Each sailor \$97,25 cents.

19. A stationer sold quills at $\$1,83\frac{1}{3}$cts. per thousand, by which he cleared $\frac{3}{8}$ of the money; but as they grew scarcer, he raised them to \$2,25cts. per thousand;—what did he clear per cent. by the latter price?

Ans. $\$96,36\frac{4}{11}$cts. gained per cent. by the latter price.

20. Bought a quantity of goods for \$250, and 3 months

* The earth moves 1 degree in 3′ 59″ 20‴$\frac{4}{6}\frac{9}{1}$ of sideral time, or in 4′ of solar or tropical time.

R 2

after sold them for \$275; how much per cent. per annum did I gain by them? *Ans.* \$40.

21. In what time will the interest of \$72, 60cts. equal that of \$15,25cts. for 64 days, at any rate of interest? Ans. $13\frac{161}{363}$ days.

22. What sum of money will amount to \$132,81cts. $2\frac{1}{2}$m. in 15 months, at 5 per cent. per annum simple interest? *Ans.* \$125.

23. A person possessed of $\frac{3}{8}$ of a ship, sold $\frac{2}{3}$ of his share for \$1260; what was the reputed value of the whole at the same rate? *Ans.* 5040.

24. Of my $\frac{3}{16}$ of a farm I sell $\frac{2}{5}$ of $\frac{4}{9}$; what I then own is worth \$185; what is that part, and what the value of the farm? Ans. $\frac{37}{240}$, and the farm \$1200.

25. What number is that to which if $\frac{3}{10}$ of $\frac{18}{7}$ of $\frac{141}{213}$ be added, the total will be one? Ans. $\frac{3648}{7455}$.

26. If $\frac{3}{7}$ of $\frac{4}{5}$ of $\frac{7}{8}$ of a ship be worth $\frac{1}{9}$ of $\frac{6}{7}$ of $\frac{11}{13}$ of the cargo, valued at 40000 dollars; what is the value of the ship and cargo? *Ans.* \$50744,81cts.+

27. A grocer would mix a quantity of sugar at 10d. per pound, with other sugars at $7\frac{1}{2}$d. 5d. and $4\frac{1}{2}$d. per pound, intending to make up a compound worth 6d. per pound; what quantity of each must he take? Ans. $1\frac{1}{2}$ lb at 10d. 1 lb at $7\frac{1}{2}$d. $1\frac{1}{2}$ lb at 5d. and 4 lb at $4\frac{1}{2}$d.

28. If 1000 men besieged in a town, with provisions for 5 weeks, allowing each man 16 ounces a day, were reinforced with 500 men more, and hear that they cannot be relieved till the end of 8 weeks; how many ounces a day must each man have, that the provisions may last that time? Ans. $6\frac{2}{3}$ ounces.

29. Sound, not interrupted, is found by expriment to move uniformly about 1150 feet in a second of time; how long then, after firing an alarm gun at Fort Independence, may the same be heard at Cambridge, taking the distance at $5\frac{3}{4}$ miles? Ans. $26\frac{24}{60}$ seconds.

30. If I see the flash of a gun fired by a vessel in distress at sea, which happens, we will suppose, at the instant of its going off, and hear the report a minute and 3 seconds afterwards; how far is she off? Ans. 72450 feet.

31. An elm plank is 14 feet, 3 inches long; what distance from the edge must a line be struck to take off a yard square? Ans. $7\frac{11}{19}$ inches.

32. A man dying, left his wife in expectation that a child would be afterwards added to the family, and in making his will he ordered, that if the child were a son, $\frac{2}{3}$ of his estate should belong to him, and the remainder to his mother; but if it were a daughter, he appointed the mother $\frac{2}{3}$ and the child the remainder; but it happened that the addition was both a son and a daughter, by which the widow lost in equity 2400 dollars more than if there had been only a girl; what would have been her dowry, had she had only a son? Ans. \$2100.

33. Having a piece of land 11 perches in breadth, I demand what length of it must be taken to contain an acre, when four perches in breadth require 40 perches in length to contain the same? Ans. 14per. 3yds.

34. If a gentleman whose annual income is £1000, spends 20 guineas, each 21s. a week, will he fall in debt, or save money, and how much in the year?

Ans. £92 in debt.

35. What sum of money will produce as much interest in $3\frac{1}{4}$ years, as \$210, 15 cents, can produce in 5 years and 5 months? Ans. \$350,25cts.

36. If \$100 in 5 years be allowed to gain \$20, 50 cents, in what time will any sum of money double itself, at the same rate of interest? Ans $24\frac{16}{41}$ years.

37. What difference is there between the interest of \$350 at 4 per cent. for 8 years, and the discount of the same sum, at the same rate, and for the same time?

Ans. \$27,15$\frac{5}{33}$cts.

38. If by selling goods at \$$2\frac{1}{2}$ per cwt. I gain 20 per cent, what do I gain or lose per cent. by selling at \$$2\frac{1}{4}$ per cwt.? Ans. \$8 per cent. gain.

39. Required the length of a shore, which, strutting 11 feet from the upright of a building, may support a jamb 23 feet, 9 inches from the ground. Ans. 26ft. 2in.+

40. A clears \$13 in 6 months, B \$18 in 5, and C \$23 in 9, his stock being \$$72\frac{1}{2}$; what, then, is the general stock? Ans. \$236,09$\frac{1}{2}\frac{8}{3}$cts.

41. A person making his will, gave to one child $\frac{13}{20}$ of his estate, and the rest to another; when these legacies came to be paid, the one turned out \$600 more than the other: what did the testator die worth? Ans. \$2000.

42. A father devised $\frac{7}{18}$ of his estate to one of his sons, and $\frac{7}{18}$ of the residue to another, and the remainder to his

widow for life; the children's legacies were found to be \$257,16$\frac{2}{3}$cts. different:—pray what sum did he leave the widow the use of? Ans. \$635,04$\frac{62}{147}$cts.

43. A had 12 pipes of wine, which he parted with to B at 4$\frac{1}{2}$ per cent. profit, who sold them to C for \$40,60cts. advantage; C made them over to D for \$605,50cts., and cleared thereby 6 per cent.:—how much a gallon did this wine cost A? Ans. 33$\frac{6458}{11077}$cts.

44. Laid out \$165,75cts. in wine at 21$\frac{1}{4}$cts. a gallon; some of which receiving damage in carriage, I sold the rest at 31$\frac{2}{3}$cts. a gallon, which produced only \$110,83$\frac{1}{3}$cts.; what quantity was damaged? Ans. 430 gallons.

45. A young hare starts 40 yards before a greyhound, and is not perceived by him till she has been up 40 seconds; she scuds away at the rate of ten miles an hour, and the dog, on view, makes after her at the rate of 18; how long will the course hold, and what ground will be run over by the dog? Ans. 60$\frac{5}{22}$sec. and 530yds. run.

46. If I leave Hallowell at 8 o'clock on Monday morning, for Newburyport, and ride at the rate of 3 miles an hour without intermission; and B sets out from Newburyport for Hallowell, at 4 o'clock the same evening, and rides 4 miles an hour constantly; supposing the distance between the two towns to be 130 miles, whereabout on the road shall we meet?

Ans. 69$\frac{3}{7}$ miles from Hallowell, which will be in Saco.

47. X, Y, and Z, can, working together, complete a staircase in 12 days; Z is man enough to do it alone in 24 days, and X in 34; in what time, then, could Y get it done himself? Ans. 81$\frac{3}{5}$ days.

48. A and B, together, can build a boat in 18 days, and with the assistance of C, they can do it in 11 days; in what time then, would C do it himself?

Ans. 28$\frac{2}{7}$ days.

49. Laid out in a lot of muslin £500, upon examination of which, 3 parts in 9 proved damaged, so that I could make but 5s. a yard of the same; and by so doing, find I lost £50 by it; at what rate per ell English am I to part with the undamaged muslin, in order to gain £50 upon the whole? Ans. 11s. 7$\frac{2}{7}$d.

50. If the sun move every day, one degree, and the moon thirteen; and, at a certain time, the sun be at the

12 : 1 :: $\frac{1}{12}$
24 : 1 :: $\frac{1}{24}$
34 : 1 :: $\frac{1}{34}$
$\frac{1}{24} + \frac{1}{34} = \frac{120}{5792}$
1 :: 5792 : 81 $\frac{3}{5}$

18 : 1 :: $\frac{1}{18}$
11 : 1 :: $\frac{1}{11}$
$\frac{1}{11} - \frac{1}{18} = \frac{7}{198}$
7 : 1 :: 198 : 28

beginning of Cancer, and, in three days after, the moon at the beginning of Aries; the place of their next following conjunction is required. Ans. 16° 45′ of Cancer.

51. A person being asked the time of day, answered, it is between 4 and 5; but a more particular answer being required, he said, that the hour and minute hands were then exactly together; what was the time?

Ans. $21\frac{9}{11}$min. past 4.

52. What weight, hung at 70 inches distance from the fulcrum of a steelyard, will equiponderate a hhd. of tobacco, weighing 950℔. freely suspended at 2 inches distance on the contrary side? *A*ns. 27℔. 2oz. $4\frac{4}{7}$drs.

53. If two places lie so much due east and west of each other, that it is found, by observation, to be noon at the former 2 hours, 6 minutes and 30 seconds sooner than at the latter; how many degrees are they apart?

*A*ns. 31° 37′ 30 seconds.

54. If Paris, in France, be in 2° 20′ east longitude from Greenwich, and Hallowell in 69° 42′ west longitude from Greenwich; when it is noon at Paris, what time of day is it at Hallowell?

Ans. 7h. 11m. 52s. in the morning.

MEASUREMENT OF GRINDSTONES.

Grindstones are sold by the stone, and their contents found as follows:*

Rule.—To the whole diameter add half of the diameeter, and multiply the sum of these by the same half, and this product by the thickness; divide this last number by 1728, and the quotient is the contents, or answer required.

EXAMPLES.

1. What are the contents of a grindstone 24 inches diameter, and 4 inches thick?

$$\frac{\overline{24+12}\times12\times4}{1728}=1 \text{ stone. } Ans.$$

2. What are the contents of a grindstone 36 inches diameter, and 4 inches thick. *A*ns. $2\frac{1}{4}$ stone.

* 24 inches in diameter, and 4 inches thick, make a stone.

MENSURATION of Superficies and Solids.

SECTION I.—*OF SUPERFICES.*

Superficial measure is that which relates to length and breadth only, not regarding thickness. It is made up of squares, either greater or less, according to the different measures by which the dimensions of the figure are taken or measured. Land is measured by this measure, its dimensions being usually taken in acres, rods, and links. The contents of boards, also, are found by this measure, their dimensions being taken in feet and inches. Because 12 inches in length make 1 foot of long measure, therefore $12\times12=144$, the square inches in a superficial foot, &c.

Case 1.—*To find the area of a square having equal sides.*

Rule.—Multiply the side of the square into itself, and the product will be the area, or superficial content, of the same name with the denomination taken, whether inches, feet, yards, rods and links, or acres.

EXAMPLES.

1. How many square feet of boards are contained in the floor of a room which is 20 feet square?

$20\times20=400$ feet, the answer.

2. Suppose a square lot of land measures 26 rods on each side, how many acres does it contain?

As 160 square rods make an acre: therefore $\frac{26\times26}{160}=$4ac. 36 rods *Ans.*

Case 2.—*To measure a parallelogram or long square.*

Rule.—Multiply the length by the breadth, and the product will be the area, or superficial content, in the same name as that in which the dimension was taken whether inches, feet or rods, &c.

EXAMPLES.

1. A certain garden, in form of a long square, is 96 feet long, and 54 feet wide; how many square feet of ground are contained in it? $96\times54=5184$ square feet. Ans.

2. A lot of land, in form of a long square, is 120 rods in length, and 60 rods wide; how many acres are in it? $120\times60=7200$ sq. rods. And $7200\div160=45$ acres, Ans.

3. How many acres are in a field of oblong form, whose length is 14,5 chains, and breadth 9,75 chains?

Ans. 14ac. 0rood. 22rods.

NOTE.—The Gunter's chain is 66 feet or 4 rods long, and contains 100 links. Therefore, if dimensions be given in chains and decimals, point off from the product one more decimal place than are contained in both factors, and it will be acres and decimals of an acre; if in chains and links, do the same, because links are hundredths of chains, and, therefore, the same as decimals of them. Or, as 1 chain wide, and 10 chains long, or 10 square chains, or 100000 square links, make an acre, it is the same as if you divide the links in the area by 100000.

4. If a board or plank be 21 feet long, and 18 inches broad, how many square feet are contained in it?

18 *inches* $=1,5$ foot. And $21\times1,5=31,5$ feet. *Ans.*

Or, in measuring boards, you may multiply the length in feet by the breadth in inches, and divide the product by 12; the quotient will give the answer in square feet, &c.

Thus, in the preceding example, $\frac{21\times18}{12}=31\frac{1}{2}$ sq. feet as before.

5. If a board be 8 inches wide, how much in length will make a foot square?

RULE.—Divide 144 by the width; thus, 8)144

Ans. 18 inch.

6. If a piece of land be 5 rods wide, how many rods in length will make an acre?

RULE.—Divide 160 by the width, and the quotient will be the length required; thus,

5)160

32 rods in length. *Ans.*

NOTE.—When a board, or any other surface, is wider at one end than the other, but yet is of a true taper, you may take the breadth in the middle, or add the width of both ends together, and halve the sum, for the mean width: then multiply the said mean breadth in either case, by the length; the product is the answer, or area sought.

7. How many square feet in a board 10 feet long, and 13 inches wide at one end, and 9 inches wide at the other?

$$\frac{13+9}{2}=11 \text{ inches mean width.}$$

$$\frac{\overset{\text{ft. in.}}{10\times11}}{12}=9\tfrac{1}{6}\text{ft. Ans.}$$

8. How many acres are in a lot of land which is 40 rods long, and 30 rods wide at one end, and 20 rods wide at the other?

$$\frac{30+20}{2}=25 \text{ rods mean width.}$$

$$\text{Then, } \frac{25\times40}{160}=6\tfrac{1}{4} \text{ acres. } \textit{Ans.}$$

9. If a farm lie 250 rods on the road, and, at one end, be 75 rods wide, and at the other, 55 rods wide, how many acres does it contain? Ans. 101ac. 2roo. 10ro.

Case 3.—*To measure the surface of a triangle.*

Definition.—A triangle is any three cornered figure which is bounded by three right lines.*

Rule.—Multiply the base of the given triangle into half its perpendicular height, or half the base into the whole perpendicular, and the product will be the area.

EXAMPLES.

1. Required the area of a triangle whose base or longest side is 32 inches, and the perpendicular height 14 inches. $14\div2=7=\frac{1}{2}$ the perpend. and $32\times7=224$ sq. in. *Ans.*

2. There is a triangular or three cornered lot of land, whose base or longest side is $51\frac{1}{2}$ rods; the perpendicular, from the corner opposite to the base, measures 44 rods; how many acres does it contain?

$44\div2=22=$half the perpendicular.

$$\text{And } \frac{51{,}5\times22}{160}=7 \text{ acres, 13 rods. } \textit{Ans.}$$

* A triangle may be either right-angled or oblique; in either case, the teacher can easily give the scholar a just idea of the base and perpendicular, by marking it down on a slate or paper, &c. In a right-angled triangle, the longest of the two legs which include the right-angle is called the base; but in such as are oblique, the longest of the three sides is so called.

3. If a piece of land lie in the form of a right-angled triangle, its base being 37 rods, and the perpendicular line being $24\frac{3}{4}$ rods, how many acres are in it?

Ans. 2,8617+acres.

4. If the base of a triangular field be 7 chains and 50 links, and the perpendicular 4 chains and 25 links, how much does it contain? Ans. 1ac. 2roods 15rods.

Joists and Planks are measured by the following

Rule.—Find the area of one side of the joist or plank, by one of the preceding rules; then multiply it by the thickness in inches; and the last product will be the superficial content.

EXAMPLES.

1. What is the area, or superficial content, or board measure, of a joist, 20 feet long, 4 inches wide, and 3 inches thick?

$$\frac{20\times4}{12}\times3=20 \text{ feet. Ans.}$$

2. If a plank be 32 feet long, 17in. wide, and 3in. thick, what is the board measure of it? *Ans.* 136 feet.

Note.—There are some numbers, the sum of whose squares makes a perfect square; such are 3 and 4, the sum of whose squares is 25, the square root of which is 5; consequently, when one leg of a right-angled triangle is 3, and the other 4, the hypotenuse must be 5. And if 3, 4, and 5, be multiplied by any other numbers each by the same, the products will be sides of true right-angled triangles. Multiplying them by 2, gives 6, 8 and 10—by 3, gives 9, 12 and 15—by 4, gives 12, 16 and 20, &c.; all which are sides of right-angled triangles. Hence, architects, in setting off the corners of buildings, commonly measure 6 feet on one side, and 8 feet on the other; then, laying a 10 feet pole across from those two points, it makes the corner a true right-angle.

Rule 2.—*To find the area of any triangle when the three sides only are given.*

Rule.—From half the sum of the three sides subtract each side severally; multiply these three remainders and the said half sum continually together; then the square root of the last product will be the area of the triangle.

EXAMPLE.

Suppose I have a triangular fish-pond, whose three sides measure 400, 348, and 312yds.; what quantity of ground does it cover? Ans. 10 acres, 3 roods, 8+rods.

CASE 4.—*To measure irregular surfaces.*

RULE.—Divide the figure or plane into triangles, by drawing diagonal lines from one angle to another; then measure all the triangles, by either of the rules in Case 3; and the sum of their several areas will be the area of the given figure.

EXAMPLE.

If a piece of ground be divided into two triangles by a diagonal line drawn through it measuring 30 rods, and two perpendiculars be let fall, one measuring 8 rods, and the other 14 rods; how many acres does it contain?

Ans. $2\frac{1}{16}$ acres.

CASE 5.—*To measure a circle.*

Definition.—A circle is a figure bounded by a curve or circular line, every part of which is equally distant from the middle or centre. The curve line is called the *periphery* or circumference; a line drawn, from one side to the other, through the centre, is called the *diameter*; and a line drawn, from the centre to the circumference, is called the *semidiameter*, (half diameter,) or radius.

PROBLEM I.

The diameter given to find the circumference.

RULE.—As 7 are to 22, so is the given diameter to the circumference; or, more exactly, as 113 are to 355, so is the diameter to the circumference, &c.

EXAMPLES.

1. What is the circumference of a wheel whose diameter is 4 feet?

As 7 : 22 : : 4 : 12,57+feet the circumference. Ans.

2. What is the circumference of a circle whose diameter is 35 rods? As 7 : 22 : : 35 : 110 rods. Ans.

NOTE.—To find the diameter, when the circumference is given, reverse the foregoing rule, and say, as 22 are to 7, so is the given circumference to the required diameter; or, as 355 are to 113, so is the circumference to the diameter.

3. What is the diameter of a circle whose circumference is 110 rods?

As 22 : 7 : : 110 : 35 rods the diam. Ans.

Problem II.

To find the area of a circle.

Rule.—Multiply half the diameter by half the circumference, and the product is the area; or, if the diameter alone is given, multiply the square of the diameter by ,785398, or, which is near enough, by ,7854—and the product will be the area.

EXAMPLES.

1. Required the area, or superficial content of a circle whose diameter is 12 rods, and circumference 37,7 rods.

18,85=half the circumference.
6=half the diameter.

113,10 area in square rods. Ans.

2. What is the superficial content of a circular garden whose diameter is 11 rods?

By the second method.

11×11=121. ,7854×121=95,0334 rods. Ans.

3. What will be the cost of a circular platform to the curb of a round well, at 10½ cents per square foot; if the diameter of the well be 42 inches, and the breadth of the platform be 14½ inches? Ans. $1,87½cts.+

Problem III.

To find the area of a circle when the circumference alone is given.

Rule.—Multiply the square of the circumference by ,079577, or, which is near enough, by ,07958—and the product will be the area.

Note.—,785398 is the area of a circle whose diameter is 1, and ,079577 is the area of a circle whose circumference is 1.

EXAMPLE.

What is the area of a circle whose circumference is 30 rods? 30×30×,07958=71,62200 rods. Ans.

Problem IV.

The area of a circle given to find the diameter.

Rule.—Divide the area by ,7854—and the square root of the quotient is the required diameter.

EXAMPLES.

1. Required the diameter of a circle that will contain within its circumference the quantity of an acre of land. 1 acre=4840sq yds. Then $\sqrt{\frac{4840}{,7854}}$=88,5+yds. Ans.

2. In the midst of a meadow abounding with feed,
For two acres, to tether my horse, I've agreed;
How long must the rope be, that, feeding all round,
He may n't graze less or more than the two acres of ground? *A*ns. $55\frac{1}{2}$+yards.

3. A, B, and C, join to buy a grindstone. 36 inches in diameter, which cost $$3\frac{1}{3}$, and towards which A paid $$1\frac{1}{6}$, B, $$1\frac{1}{3}$, and C, $83\frac{1}{3}$cts. The waste hole for the spindle was 5 inches square. To what diameter ought the stone to be worn, when B and C begin severally to work with it allowing for the hole, and A first grinding down his share, next B, and then C?

Ans. { 29,324+inch. diameter where B begins to grind; and 19,013+in. diam. C begins.

Note.—Twice the square of the side of a square, will be the square of the diameter of its circumscribing circle.

Problem V.

The area of a circle given to find the circumference.

Rule.—Divide the given area by ,07958—and the square root of the quotient is the required circumference.

EXAMPLES.

1. The expense of turfing a round plot, at 4 pence per square yard, was £2. 9s. $9\frac{3}{4}$d. ,8; what was its circumference? Ans. 130+feet.

2. How many feet of boards will fence a round garden, containing just two acres, the fence five feet high; and what will be the expense at $6\frac{1}{4}$ mills per square foot?
*A*ns. $5231\frac{2}{5}$+ft. boards; and cost $32,69cts. $6\frac{1}{4}$m.+

Case 6.—*To measure a sector of a circle.*

Definition.—A sector is a part of a circle, contained between an arch line and two radii, or semidiameters of the circle.

Rule.—Find the length of the arch by saying, as 180 degrees are to the number of degrees in the arch, so is the radius, multiplied by 3,1416, to the length of the arch, which length, divided by 2, and multiplied by the radius, will become the required area.

EXAMPLE.

What is the area of the sector of a circle whose radius is 25 feet, its arch containing 125°?*

As 180° : 125° : : 25×3,1416 : 54.5416+feet, length of arch.

$$\text{Then, } \frac{54{,}5416}{2} \times 25 = 681{,}77 \text{ feet. } Ans.$$

RULE 2.—Find the area of a circle having the same radius; then say, as 360 degrees, [the number of degrees into which all circles are divided,] are to the area of the said circle, so is the number of degrees in the arch of the sector, to the area required.

EXAMPLE.

Required the area of a sector of a circle whose arch contains 65 degrees, and radius 35 feet. *Ans.* $695\frac{5}{36}$ sq. ft.

CASE 7.—*To find the area of a segment of a circle.*

Definition.—A segment of a circle is any part of a circle cut off by a right line drawn across the circle, which does not pass through the centre, and is always greater or less than a semicircle.

RULE.—Find the area of the sector having the same arch as the segment, by Case 6; find also the area of the triangle formed by the chord of the segment and the radii of the sector, by Case 3; subtract the area of the latter from that of the former, and the remainder will be the area of the segment, when the segment is less than a semicircle: but the sum of the two areas is the answer, when it is greater.

EXAMPLE.

What is the area of the segment, whose arch contains 55°; its chord 12,5 rods; the perpendicular of its triangle 16 rods; and its semidiameter 17,2 rods?

First, find the area of a circle whose diameter is 34,4 rods

As 7 : 22 : : 34,4 : 108,1+rods circumference.

$$\frac{108{,}1}{2} \times \frac{34{,}4}{2} = 929{,}66 \text{ area of the circle.}$$

Then, as 360° : 929,66 : : 55° : 142+area of the sector.

* As we have not been able to obtain engravings to represent any of the figures in the preceding or subsequent Examples, the Teacher will, we trust, be so good as to draw them for the pupil, on paper or a slate.

And the chord $=12,5$: the perpend. 16.

$$\frac{12,5\times16}{2}=100 \text{ rods, area of the triangle.}$$

Area of the sector $=142$
Area of the trian. $=100$

Area of the segment $=42$ rods. *Ans.*

NOTE.—A regular polygon, whose sides and angles are all equal, may be measured by dividing it into triangles, finding the area of one, and multiplying this area by the number of triangles contained in the polygon.

CASE 8.—*To describe and find the area of an ellipse or oval.*

RULE.—To describe an ellipse or oval, draw a line, set one foot of the dividers on the line, as a centre, and describe a circle; move the dividers to some other point on the same line, [but not so far but that the dividers in forming a second circle may extend within the first.] and describe a second circle of the same radius as the former; then, in the two points where the circles intersect, set the dividers to complete the sides of the oval; and through these intersecting points draw the line called the conjugate diameter, crossing the line first drawn called the transverse diameter, in the centre of the oval.

RULE.—To find the area of an ellipse, multiply the transverse, or longest diameter, by the conjugate, or shortest diameter, and their product by ,7854: and the last product is the area required.

EXAMPLE.

If the transverse diameter of an oval fish pond be 34 rods, and the conjugate diameter be 24 rods, what is its area? $34\times24\times,7854=640,8864$ rods. *Ans.*

CASE 9.—*To find the area of a globe or sphere.*

Definition.—A sphere or globe is a round solid body, in the middle or centre of which is an imaginary point, from which every part of the surface is equally distant. An apple, or a ball used by children in some of their pastimes, may be called a sphere or globe.

RULE.—Multiply the circumference by the diameter and the product will be the area, or surface.

EXAMPLES.

1. What is the superficial content of the earth, if it be 360 degrees in circumference, and every degree measure $69\frac{1}{2}$ miles?

$360 \times 69\frac{1}{2} = 25020$ circumf. $355 : 113 :: 25020 : 7964+$ diameter.

And $25020 \times 7964 = 199259280$ area in squa. miles. *Ans.*

2. If the moon's diameter be 2180 miles, what is her area? *Ans.* 14928640+square miles.

SECTION II.—*OF SOLIDS.*

Solids are measured by the solid inch, foot, or yard, &c. 1728 of these inches, that is $12 \times 12 \times 12$, make 1 cubic or solid foot.

CASE 1.—*To measure a Cube.*

Definition.—A cube is a solid of six equal sides, each of which is an exact square.

RULE.—Multiply the side by itself, and that product by the same side, and this last product will be the solid content of the cube.

EXAMPLES.

1. If the side of a cubic block be 18 inches, or 1 foot and 6 inches, how many solid feet does it contain?

1ft. 6in. $= 1{,}5$ft. and $1{,}5 \times 1{,}5 \times 1{,}5 = 3{,}375$ solid ft. *Ans.*

$$\text{Or, } \frac{\overset{\text{in.}}{18} \times \overset{\text{in.}}{18} \times \overset{\text{in.}}{18}}{1728} = 3{,}375 \text{ as before.}$$

2. Suppose a cellar is to be dug which shall contain 12 feet every way, in length, breadth, and depth; how many solid feet of earth must be taken out to complete it?

Ans. 1728 sol. ft.

CASE 2.—*To find the content of any regular solid, of three dimensions, length, breadth, and thickness, such as a piece of square timber, whose length is more than its breadth and depth.*

RULE.—Multiply the breadth by the depth or thickness, and that product by the length; the last product is the solid content.

EXAMPLES.

1. How many solid feet are there in a piece of square timber that is 1 foot and 6 inches, or 18 inches broad, 9 inches thick, and 9 feet, or 108 inches long?

1ft. 6in.=1,5 foot. ,75×1,5×9=10,125 sol. ft. *Ans.*
9 inches=,75 foot.

$$\text{Or, } \frac{\overset{\text{in.}}{18}\times\overset{\text{in.}}{9}\times\overset{\text{in.}}{108}}{1728}=10{,}125 \text{ as before.}$$

In measuring timber, however, you may multiply the breadth in inches by the depth in inches, and that product by the length in feet: divide this last product by 144 and the quotient will be the solid content in feet, &c.

2. How many solid feet does a piece of square timber, or a block of marble, contain, if it be 16 inches broad, 11 inches thick, and 20 feet long?

16×11×20=3520, and 3520÷144=24,4+sol. ft. *Ans.*

3. If a stick of square timber be 15 inches broad, 8 inches thick, and 25 feet long, how many solid feet are in it? Ans. 20,8+feet.

CASE 3.—*When the breadth and thickness of a piece of square timber are given in inches, to find how much in length will make a solid foot.*

RULE.—Divide 1728 by the product of the breadth and depth, and the quotient will be the length, making a solid foot.

EXAMPLES.

1. In a piece of square timber 11 inches broad and 8 inches deep, what length will make a solid foot?

11×8=88)1728(19,6+inches. Ans.

2. In a piece of square timber 18 inches broad and 14 inches deep, what length will make a solid foot?

Ans. 6,8+inches.

CASE 4.—*To measure a cylinder.*

Definition.—A cylinder is a round body whose bases or ends are circles, like a round column or stick of timber, of equal bigness from end to end.

RULE.—Multiply the square of the diameter of the base or end by ,7854, which will give the area of the base; then multiply the area of the base by the length, and the product will be the solid content.

EXAMPLES.

1. What is the solid content of a round stick of timber, or a marble column, of equal bigness from end to end, whose diameter is 18 inches, and length 20 feet?

18 inches $=1,5$ft. $1,5\times1,5\times,7854=1,76715$ area of the base. $1,76715\times20$ length $=35,343$ solid feet. *Ans.*

Or, $18\times18\times,7854=254,4696$ inches, area of the base.

$$\frac{254,4696\times20}{144}=35,343 \text{ as before.}$$

2. What is the solid content of a round stick of timber, of equal bigness from end to end, whose diameter is 35 inches, and length 35 feet? *Ans.* 233,847 feet.

CASE 5.—*To find how many solid feet a round stick of timber, equally thick from end to end, will contain, when hewn square.*

RULE.—Multiply twice the square of its semidiameter, in inches, by the length in feet; then divide the product by 144, and the quotient will be the answer.

EXAMPLES.

1. If the diameter of a round stick of timber be 22 inches, and its length 20 feet, how many solid feet will it contain when hewn square?

Half diameter $=11$, and $\frac{11\times11\times2\times20}{144}=33,6+$ft. the solidity when hewn square, the answer.

2. If the diameter of a round stick of timber be 24 inches from end to end, and its length 20 feet, how many solid feet will it contain, when hewn square, and what will be the content of the slabs which reduce it to a square?

Ans. $\begin{cases}\text{40 feet solidity when hewn square, and}\\ \text{22,832ft. the solidity of the slabs.}\end{cases}$

CASE 6.—*To find how many feet of square edged boards, of a given thickness, can be sawn from a log of a given diameter.*

RULE.—Find the solid content of the log, when made square, by the last Case; then say, as the thickness of the board, including the saw calf, is to the solid feet, so are 12 inches to the number of feet of boards.

EXAMPLES.

1. How many feet of square edged boards, $1\frac{1}{4}$ inch thick, including the saw calf, can be sawn from a log 20 feet long, and 24 inches diameter?

$$\frac{12\times12\times2\times20}{144}=40\text{ft. solid content when hewn square.}$$

As $1\frac{1}{4}$: 40 : : 12 : 384 feet. Ans.

2. How many feet of square edged boards, $1\frac{1}{2}$ inch thick, including the saw gap, can be sawn from a log 12 feet long, and 18 inches diameter? Ans. 108 feet.

Note.—A short rule for finding the number of feet of one inch boards that a log will make, is to deduct $\frac{1}{4}$ of its diameter in inches, and $\frac{1}{4}$ of its length in feet; then for each inch of diameter that remains, reckon 1 board of the same width as this reduced diameter, and of the same length as this reduced length of the log: thus a log 12 feet long, and 12 inches through, gives 9 boards, 9 feet long, 9 inches wide, or $60\frac{3}{4}$ feet—a log 16 feet long, and 16 inches through, gives 12 boards, 12 inches wide, 12 feet long, or 144 feet.

Case 7.—*The length, breadth, and depth of any cubical box being given, to find how many bushels it will contain.*

Rule.—Multiply the length, breadth and depth together, in inches, and divide the last product by 2150,425, the solid inches in the statute bushel, and the quotient will be the answer.

EXAMPLE.

There is a square or cubical box; the length of its bottom is 50 inches, breadth of do. 40 inches, and its depth 60 inches; how many bushels of corn will it hold?

$$\frac{50\times40\times60}{2150,425}=55,8+\text{ or }55\text{ bushels 3 pecks. Ans.}$$

Case 8.—*To find the solidity of a cone or pyramid, whether round, square or triangular.*

Definition.—Solids which decrease gradually from the base till they come to a point, are generally called cones or pyramids, and are of various kinds, according to the

figure of their bases; round, square, oblong, triangular, &c.; the point at the top is called the vertex, and a line drawn from the vertex, perpendicular to the base, is called the height of the pyramid.

RULE.—Find the area of the base, whether round, square, oblong, or triangular, by some one of the foregoing rules, as the case may be; then multiply this area by one third of the height, and the product will be the solid content of the pyramid.

EXAMPLES.

1. What is the solid content of a true-tapered round stick of timber, 24 feet perpendicular length, 15 inches diameter at one end, and a point at the other?

$$\frac{15\times15\times,7854\times8}{144}=9,8175 \text{ solid feet. Ans.}$$

2. What is the solid content of a square stick of timber of a true taper, 30 feet perpendicular length, 18 inches square at one end, and a point at the other? Ans. $22\frac{1}{2}$ft.

3. What is the solid content of a triangular tapering stick of timber, 21 feet long, 10 inches each side of the triangle, $8\frac{2}{3}$ inches the perpendicular of the triangle at the large end, and the other end a point?

Half perpendicular$=4,33$ and $\dfrac{4,33\times10\times7}{144}=2,1\text{ft.}+$ *Ans.*

NOTE.—If a stick of timber be hewn three square, and be equal from end to end, you find the area of the base as in the last question, in inches, multiply that area by the whole length, and divide the product by 144, to obtain the solid content.

4. If a stick of timber be hewn three square, be 12 feet long, and each side of the base 10 inches, the perpendicular of the base being $8\frac{2}{3}$ inches, what is its solidity?

Ans. $3,6+$ feet.

CASE 9.—*To find the solidity of the frustum of a cone or pyramid.*

Definition.—The frustum of a cone is what remains after the top is cut off by a plane parallel to the base, and is in the form of a log, greater at one end than the other, whether round, or hewn three or four square, &c.

RULE.—If it be the frustum of a square pyramid, multiply the side of the greater base by the side of the less; to this product add one third of the square of the difference of the sides, and the *sum* will be the mean area between the bases; then multiply this sum by the height, and it will give the content of the frustum. Or, if it be a tapering square stick of timber, take the girth of it in the middle; square ¼ of the girth, (or multiply it by itself in inches;) then say, as 144 inches to that product, so is the length, taken in feet, to the content in feet.

EXAMPLE.

What is the content of a tapering square stick of timber, whose side of the largest end is 12 inches, of the least end, 8 inches, and whose length is 30 feet, calculating it by both rules?

By the first Rule: $12\times8=96$. $12-8=4\ \dfrac{4\times4}{3}=5\frac{1}{3}$

And $\dfrac{96+5\frac{1}{3}\times30}{144}=21\frac{1}{9}$ feet. *Ans.*

By the second Rule: $\dfrac{12+8}{2}=10$in.$=\frac{1}{4}$ of the girth in the middle.

Then $10\times10=100=$area in the middle of the stick.

And, as $144 : 100 :: 30$ft. $: 20,83+$ feet. Ans.

RULE.—If it be a triangular pyramid, or a tapering three-square stick of timber, multiply the *sum* of the mean area, as found in the first rule, by ,433—and that product by the height or length. Or, multiply the area in the middle, as found in the second rule, by ,433—and then state the proportion as before.

EXAMPLE.

What is the content of a tapering three-square stick of timber, whose side of the largest end is 15 inches, of the least end, 6 inches, and whose length is 40 feet, calculating it by both rules?

By the first Rule: $15\times6=90$. $15-6=9\ \dfrac{9\times9}{3}=27$

And $\dfrac{90+27\times,433\times40}{144}=14,0725$ feet. Ans.

By the second Rule : $\frac{15+6}{2}=10,5$ in. $=\frac{1}{4}$ of the girth in the middle, if it were four-square.

Then $10,5\times10,5\times,433=47,73825$in. $=$ area in middle.
And, as $144 : 47,73825 :: 40$ feet : 13,260625ft. Ans.

RULE.—If it be a circular pyramid or cone, multiply the diameters of the two bases together, and to the product add one third of the square of the difference of the diameters; then multiply this sum by ,7854—and it will be the mean area between the two bases; multiply this area by the length of the frustum, and it will give the solid content.

Or multiply each diameter into itself; multiply one diameter by the other; multiply the sum of these products by the length; annex two ciphers to the product, and divide it by 382; the quotient will be the content, which divide by 144 for feet as in other cases.

EXAMPLE.

What is the solid content of a tapering round stick of timber, whose greatest diameter is 13 inches, the least $6\frac{1}{2}$ inches, and whose length is 24 feet, calculating it by both rules?

$13\times6,5=84,5 \qquad 13-6,5=6,5 \qquad \frac{6,5\times6,5}{3}=14,083+$

$$\text{And } \frac{84,5+14,083\times,7854\times24}{144}=12,904+\text{feet. Ans.}$$

By the second Rule;*

$$\frac{\overline{\overline{13\times13}+\overline{6,5\times6,5}+\overline{13\times6,5}}\times2400}{382}=1858,115+$$

And $1858,115\div144=12,903+$ft. Ans.

* To find the content of timber in the tree, multiply the square of 1-5 of the circumference at the middle of a tree, in inches, by twice the length in feet, and the product divided by 144 will be the content, extremely near the truth. In oak an allowance of 1-10 or 1-12 must be made for the bark, if on the tree; in other wood less. Trees of irregular growth must be measured in parts.

CASE 10.—*To find the solid content of a Sphere or Globe.*

NOTE.—For definition of a Globe, see Case 9 of Superficies.

RULE.—Find the superficial content by Case 9 of Superficies; multiply this surface by *one-sixth* of the diameter, and it will give the solidity.

Or, multiply the *cube* of the diameter by ,5236—and the product will be the solidity.*

EXAMPLE.

What is the solidity of our earth, if its diameter be 7957¾ miles, nearly, and its circumference at the equator be just 25000 miles?

$$7957,75\times25000\times\overline{7957,75}\div6=263857106187,5+\text{solid miles. Ans.}$$

CASE 11.—*To find the solid content of a frustum or segment of a Globe.*

Definition.—The frustum of a globe is any part cut off by a plane.

RULE.—To three times the square of the semidiameter of the base, add the square of the height; multiply this sum by the height, and the product again by ,5236; the last product will be the solid content.

EXAMPLE.

If the height of a coal-pit, at the chimney, be 9 feet, and the diameter at the bottom be 24 feet, how many cords of wood does it contain, allowing nothing for the chimney?

$24\div2=12$=semidiam. $12\times12\times3=432$. $9\times9=81$.

$$\text{And } \frac{\overline{432+81}\times9\times,5236}{128=\text{solid feet in a cord.}}=18,886+\text{cords. Ans.}$$

* If the diameter of a sphere be 1, its solidity will be ,5236; and if its circumference be 1, its solidity will be ,016887.

Section III.

OF CASK GAUGING.

Definition.—Gauging is the finding of the content of any Cask, Box, Tub, or other Vessel.

Among the many different rules for gauging, the following is as exact as any.

Rule.—Take the diameter at the bung and head, and length of the cask ; subtract the head diameter from the bung diameter, and note the difference.

If the staves of the cask be much curved or bulging between the bung and head, multiply the difference of diameters by ,7 ; if not quite so much curved, by ,65 ; if they bulge yet less, by ,6 ; and if they are almost or quite straight, by ,55—and add the product to the head diameter ; the sum will be a mean diameter.

Square the mean diameter, thus found, and multiply the square by the length ; divide the product by 359 for ale or beer gallons, and by 294 for wine gallons.

Note.—1. To measure the length of the cask, take the length of the stave ; then take the depth of the chimes, which, with the thickness of the heads, (that are 1 inch, $1\frac{1}{2}$ inch, or 2 inches, according to the size of the cask) being subtracted from the length of the stave, leaves the length within.

2. In taking the bung diameter observe by moving the rod backward and forward whether the stave opposite to the bung, be thicker or thiner than the rest, and if it be, make allowance accordingly.

EXAMPLE.

How many ale and wine gallons will a cask contain, whose bung diameter is 30 inches, head diameter 25 inches, and length 40 inches ?

30—25=5. 5×,7=3,5 25+3,5=28,5 mean diam.

$$\frac{28,5\times28,5\times40}{359}=90,5+\text{ale gal. } Ans.$$

$$\frac{28,5\times28,5\times40}{294}=110,51+\text{wine gal. Ans.}$$

Or, by the sliding rule. On D. is 18,94—the gauge-point for ale or beer gallons, marked A. G.: and 17,14—the gauge-point for wine gallons, marked W. G. Set the gauge-point to the length of the cask on C. and against the mean diameter, on D. you will have the answer in ale or wine gallons, accordingly as which gauge-point you make use of.*

Case 2.—*To gauge round tubs, &c.*

Rule.—Multiply one diameter by the other, and to that product add one third of the square of their difference; multiply this sum by the length and divide as before for beer or wine.

EXAMPLE.

What is the content, in beer and wine gallons, of a round tub, whose diameter at the top, within, is 40 inches, and at the bottom 34 inches, and the perpendicular height 36 inches?

$$40-34=6 \qquad \frac{6\times6}{3}=12. \qquad \frac{34\times40+12\times36}{359}=137\tfrac{1}{2}+\text{beer gal. Ans.}$$

$$\text{And} \quad \frac{34\times40+12\times36}{294}=168 \text{ wine gal. Ans.}$$

Case 3.—*To gauge a square vessel.*

Rule.—Multiply the length by the breadth, and that product by the depth; then divide by 282 for beer or ale, (the inches in a beer or ale gallon,) and by 231 for wine, &c., (the inches contained in a wine gallon,) and the quotient will be the answer.

* A rule which has been given as generally more exact, is this; multiply the product of the square of the mean diameter and the length, by 34, and point off four places from the right of the product; the figures on the left of the point will be the gallons, and those on the right decimal parts of a gallon, in wine or cider. Let the dimension be taken exactly in inches and tenths. Take the preceding Example in Case 1.

$$\frac{30+25}{2}=27{,}5 \text{ mean diam.}$$

and $27{,}5\times27{,}5\times40\times34=1028500{,}00=102\tfrac{85}{100}$ gallons of wine or cider; which is $7\tfrac{66}{100}$ gal. less than by the other.

EXAMPLE.

If a square vessel be 80 inches in length, 60 in breadth, and 40 inches deep, what is its content in beer and wine gallons?

$\dfrac{80\times60\times40}{231}=831,16+$ *Ans.* wine gal. $\dfrac{80\times60\times40}{282}=680,85+$ Ans. beer gal.

NOTE.—The content of any vessel, in feet, gallons, and bushels, may be thus found: Measure the inside of the vessel, according to the rule of the figure, and find the content, in cubic inches; then,

Divide by	1728	and the quotient will be the content in	Cubic feet.
	282		Ale or beer gal.
	231		Wine gallons.
	2150,425		Bushels.

SECTION IV.—*To find the tonnage of a ship.*

RULE.—Multiply the length of the keel by the breadth of the beam, and that product by the depth of the hold; divide the last product by 95, and the quotient is the tonnage. If double decked, half the breadth is the depth.

EXAMPLE.

If a ship be 72 feet by the keel, 24 feet by the beam, and 12 feet deep, what is the tonnage?

$\overline{72\times24\times12}\div95=218,2+$tons *Ans.*

Or, RULE 2.—Multiply the length of the keel by the breadth of the beam, and that product again by half the breadth of the beam; divide the last product by 94, and the quotient is the tonnage.*

EXAMPLE.

What is the tonnage of a ship that is 84 feet by the keel, and 28 feet by the beam? $28\div2=14$

$\overline{84\times28\times14}\div94=350,29+$tons. Ans.

NOTE.—The breadth of the beam added to two thirds the length of the keel, gives the length of a ship's main-

*Rule established by Congress. For double decked vessels; length from fore part of main stem to afterpart of stern post, above upper deck; breadth at widest part, above main wales, half of which is called the depth; deduct from length 3-5ths of breadth; multiply

mast: Therefore the length of the mainmast of the ship last mentioned, is $84\times2\div3+28=84$ feet.

To find the thickness, the proportion is as 84 to 28, so is the length of a mast in feet, to its thickness in inches. Consequently the thickness of the mast whose length was just found, is 28 inches.

Section V.—*To find the weight of anchors which cables may sustain.*

Rule.—As the strength of cables, and consequently the weights of their anchors, are proportioned to the cubes of their peripheries; therefore, as the cube of the periphery of any cable, is to the weight of its anchor, so is the cube of the periphery of any other cable, to the weight of its anchor.

EXAMPLES.

1. If a cable of 6 inches round require an anchor of $2\frac{1}{4}$cwt. what would be the weight of an anchor, for a 12 inch cable? *cwt.*

$6\times6\times6 : 2{,}25 :: 12\times12\times12 : 18$cwt. Ans.

2. If a 12 inch cable require an anchor of 18cwt. what must the circumference of a cable be, for an anchor of $2\frac{1}{4}$cwt.? *cwt.* *cwt.*

$18 : 12\times12\times12 :: 2{,}25 : 216.$ $\sqrt[3]{216}=6$in. Ans.

Section VI.—*From one solid's capacity to find anothers'.*

Rule.—As the cube of any dimension is to its given weight, so is the cube of any like dimensions to its weight.

EXAMPLES.

1. If a ship of 300 tons' burthen be 75 feet by the keel, what is the burthen of one, 100 feet by the keel, of like form; 25℔. a qr.

tons. *tons. cwt.* ℔.

$75^3 : 300 :: 100^3 : 711$ 2 $22\frac{2}{9}$. Ans.

2. If a brass cannon, $11\frac{1}{2}$inch. diameter, weigh 1000℔. what will another, 20,83 inch diameter, of like metal and shape, weigh? Ans. 5942,5697℔.+

the remainder by width, and the product by depth; divide by 95; the quotient is the true tonnage. For single-decked, take depth from under side of deck plank to ceiling in the hold; and proceed as before.

SECTION VII.

OF WOOD AND BARK MEASURE.

CASE 1.—*To find the solid content of wood and bark.*

RULE.—Multiply the length, breadth, and thickness together, agreeably to the rule of Duodecimals, and the last product will be the solid content of the pile, parcel, or load.

EXAMPLE.

If a load of wood be 8 feet 4 inches long, 3 feet 8 inches wide, and 4 feet 6 inches high, how many cubic feet does it contain?

$8\text{ ft. }4' \times 3\text{ ft. }8' \times 4\text{ ft. }6' = 137\frac{1}{2}$ sol. ft. Ans.

CASE 2.—*To find how many cords of wood or bark are contained in any pile, &c.*

RULE.—Find the solid content as before, and divide that product by 128; the quotient will be the cords, and the remainder cubic feet, or so many 128ths of a cord. Or, divide the solid content of the pile, &c. by 16, and the quotient will be cord-feet, 8 of them being 1 cord, and the remainder so many 16ths of a cord-foot.

EXAMPLES.

1. In a pile or load of wood 9 feet 4 inches long, 3 feet 8 inches wide, and 4 feet 9 inches high, how many cords, and how many cord-feet?

$9\text{ ft. }4' \times 3\text{ ft. }8' \times 4\text{ ft. }9' = 162\text{ sol. ft. }6'\ 8''$ And $162\ 6'\ 8'' \div 128 = 1$ cord,

and 34 sol. ft. $6'\ 8''$ Ans.

Or, $162\text{ ft. }6'\ 8'' \div 16 = 10\frac{1}{8}$ cord ft. $6'\ 8'' = 1$ cord $2\frac{1}{8}$ feet. Ans.

2. If a load of wood or bark be 8 feet long, 4 feet wide, and 2 feet 6 inches high, how many cord-feet does it contain? Ans. 5 feet, or $\frac{5}{8}$ of a cord.

MODE OF ASSESSING TAXES.

It may not perhaps, be here amiss to show the general method of Assessing Taxes. But as the quantity of new matter with which we have enlarged this edition of our Work, has extended its pages considerably beyond the limits first intended, a brief explanation of the general principle and rule, will, we trust, fully suffice for the purpose.

ARGUMENT.

There is a certain town which contains 8 inhabitants. whom we will call A, B, C, D, E, F, G, and H. The town is divided into 2 school districts or classes, which are numbered 1 & 2. A, B, C, and D, form District No. 1. and E, F, G, and H, No 2. On these inhabitants the following taxes are to be assessed, namely :

State,	$14, 88cts. 6m.	Town,	$39, 69cts. 6m.
County,	$19, 84cts. 8m.	School,	$29, 77cts. 2m.

And the Highway Tax is to be equal to each person's amount of inventory.*—The first step is, to learn at what rates the various species of property are to be taxed, agreeably to the laws of the State, by which they have been fixed; and for that purpose all assessors consult, of course, the latest acts that have been passed on the subject.

Let a poll be taxed $1,30 ; an acre of orchard 25cts. ; an acre of tillage 16cts. ; an acre of mowing 16cts. ; an acre of pasturage 4cts. ; an ox of five years 35cts. ; and a cow 20cts.

In order to find each person's proportion of the several taxes, and each school district's proportion of money, according to the rateable estates of the members of each district or class, or according to the number of scholars in each district ; each man's inventory must be taken, and the amount cast by the following rule.

Rule.—Multiply the value of a poll by his number of polls ; his acres of orchard by the tax-value of one ; his number of oxen by the tax-rate of one ; and so of every other kind of property ; add the products, and the sum is the amount of his rateable estate ; find the amount of all in the same way ; add these amounts, and their sum is the value of the inventory of the town.

I demand the rateable estate of A, who has

2 Polls,	at $1,30 amount to	$2,60
2 Acres of tillage,	at 0,16	0,32
5 Acres of mowing,	at 0,16	0,80
2 Oxen,	at 0,35	0,70
Amount of A's rateable estate,		$4,42

Find the other amounts in the following inventory, in the same way.

TO PROVE THE INVENTORY.

Rule.—Add up the column of polls, and multiply the sum by the value of one : add up each of the other columns, and multiply its sum by the tax-rate of one in that column ; then add the several amounts of the columns together, and the sum will be equal to the total amount of the inventory, if the work be right.

EXAMPLE.

The total amount of rateable estates in the following inventory, is $49, 62 cents. And proceeding by the method given in the rule of proof, the sum of the products is $49, 62 cents. It is, therefore, evident the work is right.

* Assess *money* taxes so far over the sum to be raised, as to meet abatements.

INVENTORY.

Names.	Polls.	Acr's of Orchard.	Acres of Tillage.	Acr's of Mowing.	Acres of Pasture.	Oxen 5 years old.	Cows.	Total amount of each Estimate.
A	2		2	5		2		$4,42
B	1	3	5	2	4		1	3,53
C	4	6	3	8	10	2	2	9,96
D	1						1	1,50
E	3		10	5	8		2	7,02
F	1	5	4	6	5	2	1	5,25
G	2	4	8	4	6	2		6,46
H	5		12	8	12	2	3	11,48
							Total Amount,	$49,62

NOTE.—If any teacher think it best to proportion the School Money between the districts according to the number of scholars in each, instead of by the value of rateable estates in each, let the scholar do it so; and let district No. 1 contain 15, and district No. 2, 20 scholars. The inventory here given, though it exhibits but a few rateable articles, will serve to explain the principle. As minors now pay no poll-tax in Maine, no person can properly, have more than 1 poll; though he may pay the tax for his workmen and his sons who are of age.

To find each person's proportion of any tax.

RULE.—Say, as the total amount of the inventory, of the town, is to the sum to be raised in each tax, so is one dollar to that part of the tax which one dollar of the inventory, or rateable estate, must pay: then, taking the same numbers for the first and second terms, and one cent for the third term, of a new stating, find what part of the tax one cent of the inventory, or rateable estate, must pay; and from these two operations form two tax-tables; one for dollars, from 1 dollar to 11, or farther, if deemed necessary; and the other for cents, from 1 cent to 90. Then by means of these two tables, make out each person's tax.

1. To make the State tax, the sum to be raised being $14,88cts. 6m., and the total amount of the foregoing inventory $49,62cts.

As $49,62cts. : $14,88cts. 6m. : : $1,00cts. : $0,30cts.
And as $49,62cts. : $14,88cts. 6m. : : ,01cts. : ,00cts. 3m.

Therefore, $1 of the inventory pays 30 cents; and 1 cent of the inventory pays 3 mills; by which make the following two Tables.

DOLLAR TABLE,
From $1 to $11.

$1 pays	$0, 30cts.
2	0, 60
3	0, 90
4	1, 20
5	1, 50
6	1, 80
7	2, 10
8	2, 40
9	2, 70
10	3, 00
11	3, 30

CENT TABLE,
From 1 Cent to 90 Cents.

1ct. pays	0cts.	3m.	30cts. pays	9cts.
2	0	6	40	12
3	0	9	50	15
4	1	2	60	18
5	1	5	70	21
6	1	8	80	24
7	2	1	90	27
8	2	4		
9	2	7		
10	3	0		
20	6	0		

The tax is now to be made on each rateable estate, as it stands in the inventory, by means of these Tables.—First, What is A's tax, whose rateable estate is $4,42cts.?

By the table, $4 pay	$1, 20 cents.
40 cents pay	0, 12
and 2 cents pay	0, 00 6 mills.
Amount	$1, 32 6 A's tax.

Or, having found what part of the tax one cent of the inventory will pay, you may, instead of making tables, multiply the number of cents in each person's inventory, by what one cent pays, and the product will be his tax.

Now, to find, A's tax by this method:—One cent pays 3 mills, or ,3 of a cent.

Therefore, 442 cents
,3

132,6=132$\frac{6}{10}$cts. or $1,32cts. 6m. as before.

Find by these methods, the State tax of all the other persons. Then, to know if your work be right, add the several persons' taxes together, and see if the sum be just equal to the $14,88cts. 6m. that was raised for the State, which it must be, because the proportion is even.

Next, find each person's County tax in like manner, taking new statings, and forming new tables: and thus proceed with each particular tax, till you have gone through the whole, proving each part as before noted.

Lastly, form your tax list, setting down the names therein alphabetically, and carrying out in a line from each the separate sums of the respective taxes, together with the total amount of each. When done, give them a general proof, by adding together the several sums that were to be raised for the State, County, &c. taxes; and then the total amounts of each person's taxes; which two sums will come exactly alike, if there be no errour, in any part of the work.

BOOK-KEEPING.

DIRECTIONS FOR THE LEARNER.

Having ruled your books in the proper form, copy into the Daybook one day's accounts; then calculate upon your slate or waste-paper, to find if they be rightly cast up, and to exercise you in calculations. Next, rule your slate or waste-paper in the form of the Leger, and upon it post the accounts that you have copied in the Daybook, with their date prefixed; observing to set on the Dr. side of each person's account, those accounts to which he is Dr. in the Daybook, and on the Cr. side of his account, those by which he is Cr. And if any account consist of but one article, you are to express it particularly with its amount, in the columns; but if it consists of several articles, write *To* or *By Sundries*, placing the sum of the amounts of all the articles in the columns. After the accounts are, by correcting if necessary, placed according to the teacher's mind, transcribe them

into your Leger, leaving a proper space, under each person's name, to receive more accounts. Then under the proper letters in the Alphabet, enter those names with the pages where they stand in the Leger; and, lastly, write the Daybook pages to the several accounts in the Leger, by which you can readily refer to the page of the Daybook on which any Leger entry may be found, making at the same time, the marks on the Daybook which denote the several accounts to be posted. Do the same with the next day's accounts: and so on till the whole be finished. But observe that you must not enter any person's name down again which has been entered before, till the space first assigned to it shall be filled with articles; and then the account must be transferred to a new place, as you may observe is done with George Simpson's account.

EXAMPLE.

Suppose David Davis owes me 450 dollars for the balance of an account with him, April 1st, 1832; the next day, April 2d, I buy of him 200 bushels of wheat at 1 dollar 50 cents per bushel, and 100 bushels of corn at 75 cents per bushel; the next day, April 3d, I sell Jonathan Worth 150 bushels of wheat at 1 dollar 75 cents per bushel; April 4th, Jonathan Worth pays me 200 dollars in cash, and David Davis pays me 50 dollars in cash: required the Daybook and Leger of the transaction.

DAYBOOK, NO. 1.

Hallowell, April 1, 1832.

	David Davis,	*Dr.*	$	*cts.*
=	To balance due on old account, - - -		450	
	April 2.			
	David Davis,	*Cr.*		
=	By 20 bushels wheat,	at $1,50	300	00
	100 do. corn,	75	75	00
			375	00
	April 3.			
	Jonathan Worth,	*Dr.*		
=	To 150 bushels wheat,	at $1,75	262	50
	April 4.			
	Jonathan Worth,	*Cr.*		
=	By cash in part for wheat,		200	00
	David Davis,	*Cr.*		
=	By cash, fifty dollars,		50	00

To post the above accounts, open an account for David Davis, debit him for 450 dollars; and for the second day's transaction credit him for 375 dollars; for the third, open an account for Jonathan Worth, debiting him for 262 dollars 50 cents; and for the fourth day credit him for 200 dollars, and credit David Davis for 50 dollars.

LEGER, NO. 1.

1832. *Dr.* *David Davis,*

			$	Cts.
April 1	To balance of old account,	227	450	
			450	00
April 4	To balance of above account,	–	25	00

1832	*Dr.* *Jonathan Worth,*			
April 3	To wheat, - - - -	227	262	50
			262	50
4	To balance of old account,	–	62	50

By the above Leger it appears that the balances are in my favour, which, added to the cash I have on hand, and the goods unsold, show the amount of my stock, which compared with my original stock, will show my profit or loss, viz.

	$.	Cts.
David Davis owes me	25	00
Jonathan Worth do.	62	50
I have in cash,	250	00
Wheat unsold 50 bushels, valued at prime cost, $1,50	75	00
Corn do. 100 bushels do. at 75cts.	75	00
Amount of my stock,	487	50
My original stock was	450	00
I have therefore gained	$ 37	50

LEGER, NO. 1.

1832. *Contra* *Cr.*

		Fol.	$	Cts.
April 2	By Sundries, - - - -	227	375	00
4	By Cash, - - - - -	–	50	00
	By balance to new account,	–	25	00
			450	00

1832. *Contra* *Cr.*

		Fol.	$	Cts.
April 4	By cash, - - - -	227	200	00
	By balance to new account,	–	62	50
			262	50

NOTE.—If you should enter any thing in your Leger under a wrong title, or any other way false, it should not be blotted out, but marked thus (×) in the margin against it; and write on the opposite side *Errour per contra*, with the sum against it, and make the same mark in the margin.

* Opposite pages in the Leger are both numbered alike.

DAYBOOK, NO. 2.

Hallowell, April 6, 1832.

			$	cts.
	George Simpson	Dr.		
=	To balance due on old accouut,		200	
	John Barton	Dr.		
=	To balance due on account of 6 Hhds. Wine.		340	
	William Reed,	Cr.		
=	By balance due him on account of English goods pr. invoice,		462	44
	Thomas Tilton	Cr.		
=	By balance due him for 6 months service on farm,		90	
	April 8.			
	Charles Prince	Dr		
=	To 1 2 17½ ℔. sugar 25 ℔ a qr. at $12		20	10
	2 bbls. superfine flour,	at 7 50	15	00
	1 do. mess pork,		25	00
			60	10
	Richard Lewis	Dr.		
	To 2yds superfine broadcloth at $6		12	
	4 – cassimere, best blk.	15s.	10	
=	1½ doz. buttons,	5s. 6d.	1	37
	1 do. small do.			38
	4 skeins sewing silk,	4½d.		25
	4 sticks twist,	4½d.		25
			24	25
=		Cr.		
	By cash in part,		15	00

Hallowell, April 13, 1832.

		$	cts
	Thomas Tilton, Dr.		
=	To cash in part of the balance due him,	50	
	his order paid Samuel Lane,	21	50
		71	50
	April 14.		
	George Simpson, Cr.		
=	By cash (per rec't.)	41	
	April 24.		
	Richard Lewis, Dr.		
	To 5 pieces India cottons, at 26s.	21	67
=	7 yds. cotton cambric, 4s. 6d.	5	25
	6 do. col'd do. 3s.	3	
		29	92
	April 25.		
	George Simpson, Cr.		
=	By check on Gardiner Bank for one hundred and fifty dollars,	150	
	April 30.		
	John Barton, Cr.		
=	By cash rec'd for 25bbls. beef sold at $10,50cts.	262	50
	June 6.		
	George Simpson, Dr.		
=	To 10 gallons wine, at $1,20.	12	

INDEX TO LEGER NO. 2.

B	Barton John,	folio 1
L	Lewis Richard,	2
P	Prince Charles,	2
R	Reed William,	1
S	Simpson George,	1, 2
T	Tilton Thomas,	2

LEGER, NO. 2.

1832. *Dr.* *George Simpson,*

		Fol.	$	cts.
April 6	To balance,	1	200	00
	Transferred to folio 2.			
			200	00

1832. *Dr.* *John Barton,* (Bath.)

April 6	To balance for wine,	1	340	00

1832. *Dr.* *William Reed,*

LEGER, No. 2.

1832.	*Contra*	*Fol.*	$	*cts.*
April 14,	By cash,	2	41	00
25,	By check on Gardiner Bank,	2	150	00
June 1,	By balance transfer'd to folio 2,		9	00
			200	00

Cr.

1832.	*Contra*			
April 30,	By cash, - - - - -	2	262	

Cr.

1832.	*Contra*			
April 6,	By balance due, - -	1	462	44

Cr.

1832. *Dr.* *Thomas Tilton,*

		Fol.	$	cts.
April 13,	To sundries, - - -	2	71	50

1832. *Dr.* *Charles Prince,*

April 8,	To sundries, - - -	1	60	10

1832. *Dr.* *Richard Lewis,* (York.)

April 8,	To sundries, - - -	1	24	25
24,	To sundries, - - -	2	29	92

1832. *Dr.* *George Simpson,*

June 1,	To balance from folio 1,		9	00
6,	To wine, - - -	2	12	00

1832.	*Contra*	*Cr.*			
				$	Cts.
April 6	By balance, - - - -		1	90	00

1832.	*Contra*	*Cr.*			

1832.	*Contra*	*Cr.*			
April 8	By cash, - - - -		1	15	00

1832.	*Contra*	*Cr.*			

A TABLE *for reducing Shillings and Pence into Cents and Mills.*

			Shil.		*Shil.*		*Shil.*		*Shil.*		*Shil.*	
	0		1		2		3		4		5	
Pn.	*cts.*	*m.*	*cts.*	*m.*	*cts.*	*m.*	*cts.*	*m.*	*cts.*	*m.*	*cts.*	*m.*
0			16	7	33	3	50	0	66	7	83	3
1	1	4	18	1	34	7	51	4	68	1	84	7
2	2	8	19	5	36	1	52	8	69	5	86	1
3	4	2	20	9	37	5	54	2	70	9	87	5
4	5	6	22	3	38	9	55	6	72	3	88	9
5	7	0	23	7	40	3	57	0	73	7	90	3
6	8	3	25	0	41	6	58	3	75	0	91	6
7	9	7	26	4	43	0	59	7	76	4	93	0
8	11	1	27	8	44	4	61	1	77	8	94	4
9	12	5	29	2	45	8	62	5	79	2	95	8
10	13	9	30	6	47	2	63	9	80	6	97	2
11	15	3	32	0	48	6	65	3	82	0	98	6

Example.—Reduce 3s. 6d. to cents and mills. Look for 3s. at the head of the column, and 6 under pence at the left hand side; then casting your eye along in that line until you come to the 3s. column, you have 58 cents 3 mills, the answer.

Tables of the value of the Gold Coins of Great Britain, France and Spain, according to the act of Congress of April 29, 1816.

[Gold Coins of France.]

gr	*ct.*	*grs.*	*ct.*	*pwt.*	*$ ct.*	*pwt.*	*$ ct.*
1	3	13	47	1	0,87	11	9,60
2	7	14	51	2	1,75	12	10,47
3	11	15	55	3	2,62	13	11.34
4	14	16	58	4	3.49	14	12,21
5	18	17	62	5	4,36	15	13,09
6	22	18	65	6	5,23	16	13,96
7	25	19	6[illegible]	7	6,11	17	14,83
8	2[illegible]	20	72	8	6,98	18	15,71
9	33	21	7[illegible]	9	7.85	19	16,58
10	36	22	8[illegible]	10	8,73	20	17,45
11	40	23	84				
12	44						

[Gold Coins of SPAIN.]

gr.	*ct.*	*gr.*	*ct.*	*pwt.*	*$ ct.*	*pt.*	*$ ct.*
1	3	13	45	1	0,84	11	9,24
2	7	14	49	2	1,68	12	10,08
3	11	15	52	3	2,52	13	10,92
4	14	16	56	4	3,36	14	11,76
5	17	17	5[illegible]	5	4,20	15	12,60
6	21	18	63	6	5,04	16	13,44
7	24	19	66	7	5,88	17	14,28
8	28	20	70	8	6,72	18	15,12
9	32	21	73	9	7,56	19	15,96
10	36	22	77	10	8,40	20	16,80
11	39	23	80				
12	42						

Gold Coins of GREAT BRITAIN and PORTUGAL.

gr	*ct.*	*gr*	*ct.*	*gr*	*ct.*	*gr*	*ct*	*pwt*	*dl.ct*	*pwt*	*dl.ct*	*pt.*	*dl cts*	*pwt*	*dl.cts*
1	3	7	25	13	48	19	70	1	0,89	7	6,22	1[illegible]	11,55	17	15,11
2	7	8	29	14	51	20	74	2	1,78	8	7,11	14	12,44	18	16,00
3	11	9	33	15	55	21	78	3	2,67	9	8,00	15	13,33	19	16,89
4	14	10	37	16	59	22	81	4	3,55	10	8,89	16	14,22	20	17,78
5	18	11	40	17	63	23	85	5	4,44	11	9,78				
6	22	12	44	18	67			6	5,33	12	10,67				

FORMS OF NOTES, BILLS, RECEIPTS, &c.

PROMISSORY NOTE.

Hallowell, June 6, 1827.

FOR value received, I promise to pay one hundred and twenty-one dollars and fifty cents to George Rich or order, in sixty days with interest. HENRY WEST.

$121,50
——— Witness, *Geo. Spelman.*

PROMISSORY NOTE BY TWO PERSONS.

Hallowell, June 6, 1827.

For value received, we jointly and severally promise to pay fifty-six dollars to A. B. or order, on demand, with interest.

C. DAVIS.
E. FOX.

$56,00
———Attest, *G. Hill.*

NOTE FOR BORROWED MONEY.

Borrowed and received of C. D. forty-nine dollars, which I promise to pay on demand. E. FOX.

$49,00

☞ A promissory note having *order* inserted, may be endorsed from one person to another; and if *value received* is not mentioned, it is of no force.

INLAND BILL OF EXCHANGE.

$1000,00 *Portland, June* 6, 1827.

Ten days after sight, pay to George Brown or order, one thousand dollars, for value received, and place it to my account without further advice, (or as advised,) from

Your humble servant, HENRY WEST.

To Mr. George Rich, Boston.

FOREIGN BILL OF EXCHANGE.

EXCHANGE for £400 sterling.

Hallowell, June 7, 1827.

Sixty days after sight, (or at usance,*) pay this my first bill of exchange, second and third of the same tenor and date not paid, to Mr. George Brown or his order, four hundred pounds sterling

* Usance is a customary time for the payment of foreign bills of exchange, circulating from one nation to another; and varies from 30 to 90 days, according to the custom of different countries.

(exchange at four shillings and sixpence per dollar) for value received, and place it (with or without further advice,) to the account of
Your humble servant,
HENRY WEST.

Messrs. Neil & Thompson,
Merchants, Liverpool.

RECEIPT FOR MONEY PAID ON NOTE.

Hallowell, Dec. 6, 1827.—Received from William Grant (by the hands of Thomas Amory) sixty-one dollars and fifty cents, which is endorsed on his note of May 16th, 1825.

SAMUEL PRINCE.

$61,50

RECEIPT FOR MONEY RECEIVED ON ACCOUNT.

June 7, 1827.—Received from D. E. (by the hands of G. H.) forty dollars on account.
L. M.

$40,00

GENERAL RECEIPT.

June 7, 1827.—Received of N. O. ten dollars and twenty-nine cents, in full of all demands.
N. B.

$10,29

N. B.—A general receipt will discharge all debts, except such as are on specialty, that is, bonds, bills, and other instruments that may properly be called acts or deeds, viz. those that require to be executed in a solemn manner, where the sealing and delivery are the most essential parts of the act, and on that account can only be destroyed or cancelled by something of equal force, viz. some other specialty, such as a general release, &c. Neither will it discharge endorseable promissory notes, or inland bills.

BANK DISCOUNT.

When a note is offered at a bank for discount, two endorsers are generally required, to the first of whom it is made payable: Thus A, having occasion to borrow money, procures B. and C, as endorsers to his note, and offers it for discount in the following form.

$500,00 *Hallowell, June* 6, 1827.

For value received I promise to pay five hundred dollars to B or order, at the Gardiner Bank, in fifty-seven days, with customary grace.
A.

The method used among bankers in discounting notes, &c. is to

find the interest of the sum from the date of the note to the time when it becomes due, including the days of grace; the interest thus found is reckoned the discount, and is taken from the amount of the note at the time, before the person receives his money.

Grace denotes a term of three days, which custom has allowed to the borrower; that is, though the note becomes due in fifty-seven days, he may withhold payment until the sixtieth, for which reason the interest is reckoned for sixty days, notwithstanding the note should be paid the fifty-seventh day.

INVOICE OF GOODS.

Boston, June 6, 1827.

Mr. N. Brown bought of

George Rich.

32 ells Mode,	at 3s. 4d.	$17 78
64 yds. Striped Nankins,	1s. 6d.	16 00
28 " Calico,	1s. 9d.	8 17
4 pieces Muslin,	30s.	20 00
56 yds. Cotton Cassimere,	2s.	18 67
20 pieces of India Cottons,	18s.	60 00
25 " plain Nankins,	6s. 6d.	27 08
2 doz. cotton Hose, (Men's,)	66s.	22 00
		$189 70

Rec'd payment by his Note at 60 days,

Geo. Rich.

ACCOUNT RENDERED.

Mr. Richard Lewis,

1827.	To A———B———, Dr.		
April 1,	To 2yds. Superfine Cloth,	at $6,00	$12 00
	4 " blk. Cassimere,	2,50	10 00
	1½ doz. Buttons,	,92	1 38
	1 " small do.		37
	4 skeins silk,	06¼	25
	4 sticks of twist,	,06¼	25
21,	5 pieces Ind. Cottons, 22yds.	ea. 4,33⅓	21 67
	7 yds. Cotton Cambric,	,75	5 25
	6 " col'd do.	,50	3 00
May 18,	14 " do. do.	,50	7 00
	7 " Linen,	,92	6 44
	1 oz. Thread, No. 40,		41
	2 pair Morocco Shoes,	1,08	2 16
	1 oz. Indigo,		25
			$70 43

Hallowell, Dec. 6, 1827.

Rec'd payment for A——— B———.

George North.

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128

18829
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